South African Sunflower Crop

Quality Report 2019/2020 Season

Compiled and issued by:
The Southern African Grain Laboratory NPC

Grain Building - Agri-Hub Office
477 Witherite Street
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

Index

South African

Commercial sunflower quality for the 2019/2020 Season

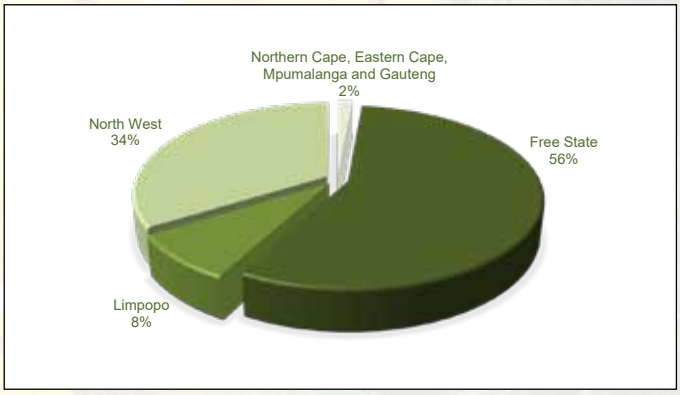
Acknowledgements
With gratitude to:

- ***The Oilseeds Advisory Committee (OAC) as well as the Oil & Protein Seed Development Trust (OPDT) 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 sunflower.*
- *The Bureau for Food and Agricultural Policy (BFAP) for providing research based market analysis.*
- *Precision Oil Laboratories for providing Fatty Acid Profile analyses.*

Introduction

The final commercial sunflower crop figure of the 2019/20 season as overseen by the National Crop Estimates Liaison Committee (CELC) is 788 500 tons, an increase of 2 590 tons or 0.33% compared to the final crop estimate figure. The crop increased by 16.3% (110 500 tons) year on year. The major sunflower-producing provinces, namely the Free State and North West, contributed 90.3% of the total crop.

Graph 1: Provincial contribution to the production of the 2019/20 sunflower crop



Figures provided by the CEC.

During the harvesting season, a representative sample of each delivery of sunflower seed 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 35. One hundred and seventy-six (176) composite sunflower samples, representing the different production regions, were analysed for quality. The samples were graded, milled and analysed for moisture, crude protein, crude fat, crude fibre and ash content. Twenty samples, randomly selected to represent the different production regions, were submitted to Precision Oil Laboratories for fatty acid profile analyses.

This is the eighth annual sunflower 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 sunflower crop, which is essential in assisting with decision making processes. The data reveal general tendencies and highlight quality differences in the commercial sunflower seed produced in different production regions nationally.

The results of this survey are available on the SAGL website (www.sagl.co.za). Hard copy reports are distributed to all Directly Affected Groups and interested parties. The report is also available to read or download in a PDF format from the website.

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 as well as information on the manufacture, import and export of oil seeds products, are also included.

The report of the Evaluation of sunflower cultivars 2019/20 season conducted by the ARC-Grain Crops in collaboration with Agricol, Pannar, Pioneer, Syngenta, Sensako and Link Seed is included in totality and as received, in this report. The national grading regulations as published in Government Notice NO. 45 of 22 January 2016 are also provided.

Production

World sunflower seed production for the 2019/20 season stands at 55.9 million metric tons with the Ukraine and Russia contributing 57% to this total. An area of 27.4 million hectares were harvested resulting in a yield of 2.04 metric tons/hectare. The forecasted figure for the 2020/21 season is 50.5 million metric tons harvested on 28.2 million hectares and with a yield of 1.79 metric tons/hectare.

Please see Table 1 for the world sunflower seed supply and disappearance figures.

Table 1: World Sunflower Seed Supply and Disappearance (October through September)

Season	2015/16	2016/17	2017/18	2018/19	2019/20 (Revised)	2020/21 (Forecast)
Area Harvested (1 000 Ha)	***25 242***	***26 964***	***26 885***	***27 265***	***27 440***	***28 226***
Yield (MT/Ha)	***1.70***	***1.86***	***1.83***	***1.91***	***2.04***	***1.79***
Production (1 000 MT)						
Argentina	2 830	3 300	3 400	3 530	3 150	2 830
European Union	7 769	8 641	10 058	9 482	9 485	8 696
China	2 698	2 750	2 580	2 550	2 680	2 730
Russia	9 700	11 600	11 000	12 756	15 379	13 200
Ukraine	12 100	15 100	13 400	15 250	16 500	14 300
United States	1 326	1 203	970	956	887	1 353
South Africa	755	874	862	678	786	780
Turkey	1 350	1 470	1 700	1 530	1 700	1 550
Other	4 386	5 130	5 086	5 292	5 346	5 020
TOTAL	***42 914***	***50 068***	***49 056***	***52 024***	***55 913***	***50 459***
Import (1 000 MT)						
Turkey	436	611	721	1 051	1 058	950
European Union	577	632	520	550	1 036	880
Other	1 100	1 396	1 322	1 445	1 401	730
TOTAL	***2 113***	***2 639***	***2 563***	***3 046***	***3 495***	***2 560***
Export (1 000 MT)						
Argentina	302	74	58	149	214	170
United States	107	99	89	87	64	80
Russia	105	362	103	338	1 261	500
Ukraine	171	261	50	119	76	180
Other	1 467	1 804	2 234	2 392	1 911	1 617
TOTAL	***2 152***	***2 600***	***2 534***	***3 085***	***3 526***	***2 547***
Oilseed crushed	***38 177***	***44 845***	***44 663***	***47 231***	***50 474***	***45 499***

National Sunflower Association website www.sunflowernsa.com, Table updated January 12, 2021; Source: Oil World & USDA.

Sunflower seed production is very suitable for South African climatic conditions as sunflower plants are drought tolerant. The deep root system of a sunflower enables the plant to perform better than other crops during dry seasons. Planting sunflowers is also advantageous when rainfall occurs late in the season, due to the late planting window relative to that of maize.

The area utilised for sunflower production decreased by 2.9% to 500 300 ha, compared to the 515 350 ha of the previous season. This season's area planted is the lowest since the 2011/12 season. The national yield average increased by almost 20% to 1.58 t/ha, this is the highest national average yield reported since the early 1980's.

According to *The Bureau for Food and Agricultural Policy (BFAP) Baseline, Agricultural Outlook 2020 – 2029*, sunflower area trends largely sideways over the next decade, reaching 590 000 hectares by 2029. Over the same period, yields are expected to increase by 21%, due largely to improvements in technology and continuous improvement of farming practices. This yield increase is sufficient to supply the growth in domestic demand.

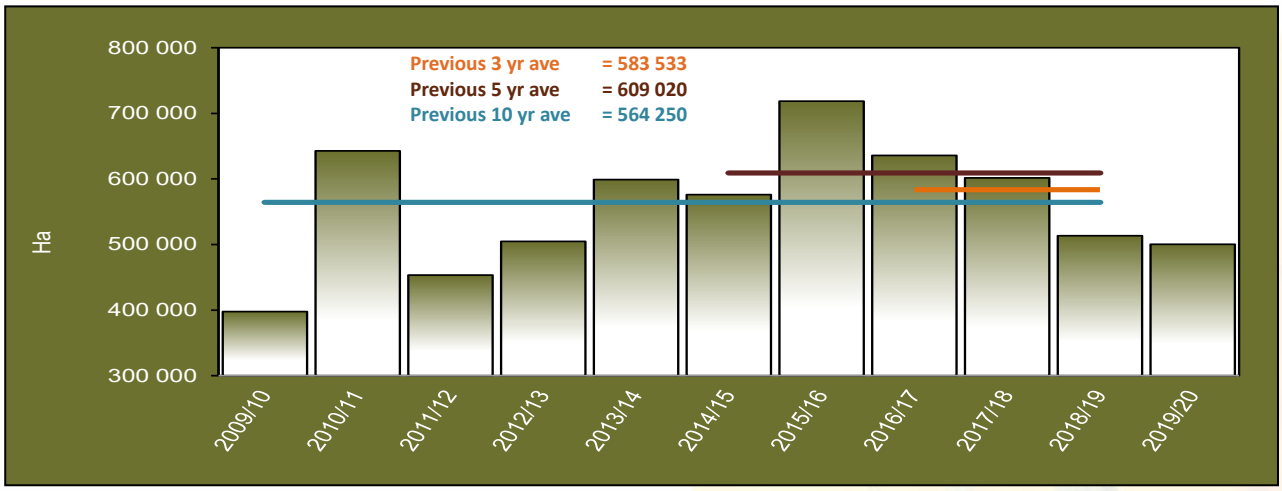
Please see Table 2 for an overview of sunflower production under dry land conditions versus irrigation in the 2019/20 season, compared to the 2018/19 season. Graphs 2 to 4 provide national figures with regards to hectares planted, tons produced and yields obtained over the last 11 seasons and Graphs 5 to 10 similar figures for the major sunflower producing provinces, namely the Free State and North West as well as Limpopo.

Table 2: Sunflower production overview over two seasons

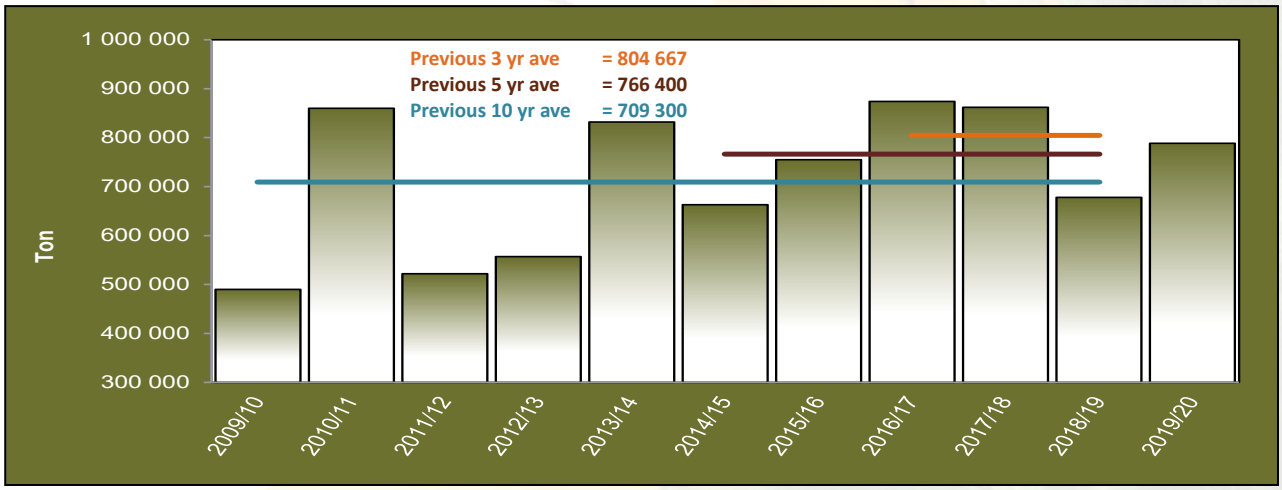
Province	Type of production	2019/20			2018/19		
		Hectares planted, ha	Production, tons	Yield, t/ha	Hectares planted, ha	Production, tons	Yield, t/ha
Western Cape	Dryland	-	-	-	-	-	-
	Irrigation	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Northern Cape	Dryland	-	-	-	-	-	-
	Irrigation	1 200	1 430	1.19	950	1 140	1.20
	Total	1 200	1 430	1.19	950	1 140	1.20
Free State	Dryland	255 500	434 350	1.70	265 500	382 050	1.44
	Irrigation	4 500	10 250	2.28	4 500	9 450	2.10
	Total	260 000	444 600	1.71	270 000	391 500	1.45
Eastern Cape	Dryland	120	280	2.33	100	260	2.60
	Irrigation	180	470	2.61	-	-	-
	Total	300	750	2.50	100	260	2.60
KwaZulu-Natal	Dryland	-	-	-	-	-	-
	Irrigation	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Mpumalanga	Dryland	2 555	3 475	1.36	4 500	4 500	1.00
	Irrigation	245	445	-	-	-	-
	Total	2 800	3 920	1.40	4 500	4 500	1.00
Limpopo	Dryland	64 000	62 800	0.98	60 000	58 800	0.98
	Irrigation	1 000	2 200	2.20	1 000	2 200	2.20
	Total	65 000	65 000	1.00	61 000	61 000	1.00
Gauteng	Dryland	3 750	5 100	1.36	3 550	3 300	0.93
	Irrigation	250	500	2.00	250	500	2.00
	Total	4 000	5 600	1.40	3 800	3 800	1.00
North West	Dryland	165 000	263 000	1.59	174 100	214 000	1.23
	Irrigation	2 000	4 200	2.10	900	1 800	2.00
	Total	167 000	267 200	1.60	175 000	215 800	1.23
RSA	Dryland	490 925	769 005	1.57	507 750	662 910	1.31
	Irrigation	9 375	19 495	2.08	7 600	15 090	1.99
	Total	500 300	788 500	1.58	515 350	678 000	1.32

Figures provided by the CEC.

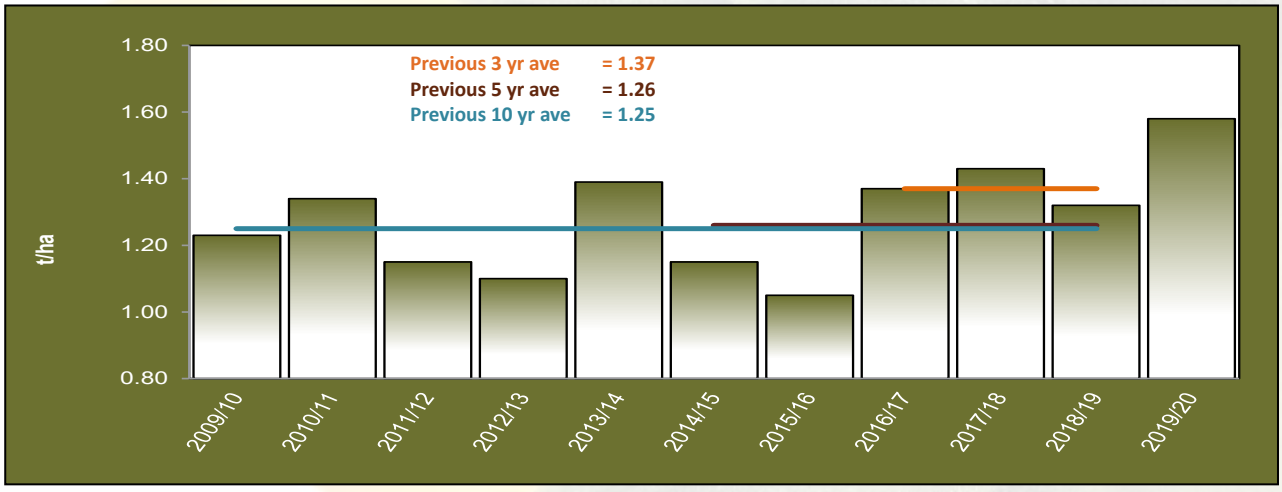
Graph 2: Total RSA area utilised for sunflower production from 2009/10 to 2019/20



Graph 3: Sunflower production in RSA from 2009/10 to 2019/20

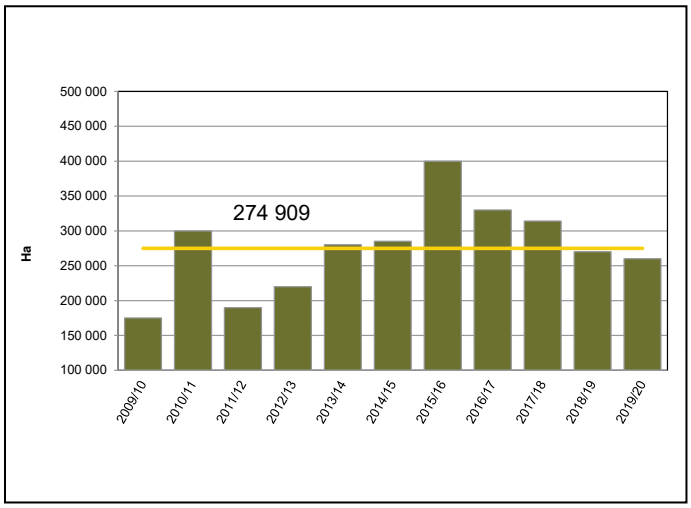


Graph 4: RSA Sunflower yield from 2009/10 to 2019/20

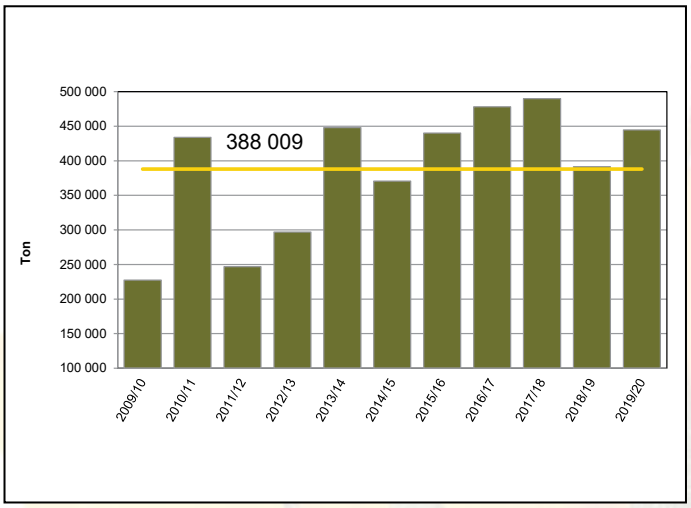


Figures provided by the CEC.

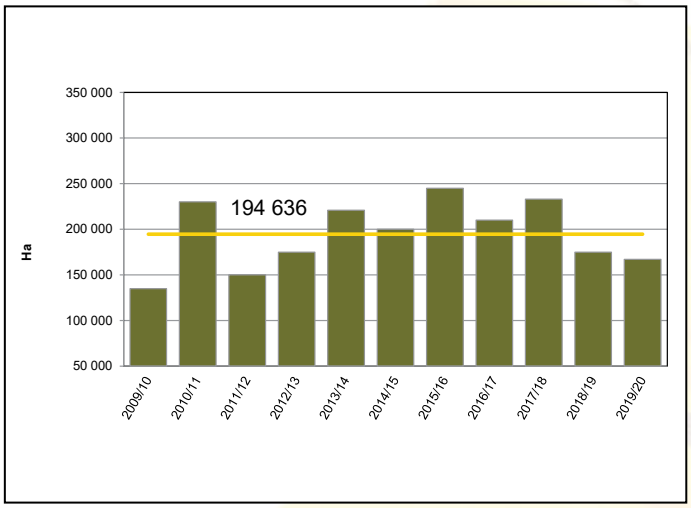
Graph 5: Area utilised for sunflower production in the Free State since 2009/10



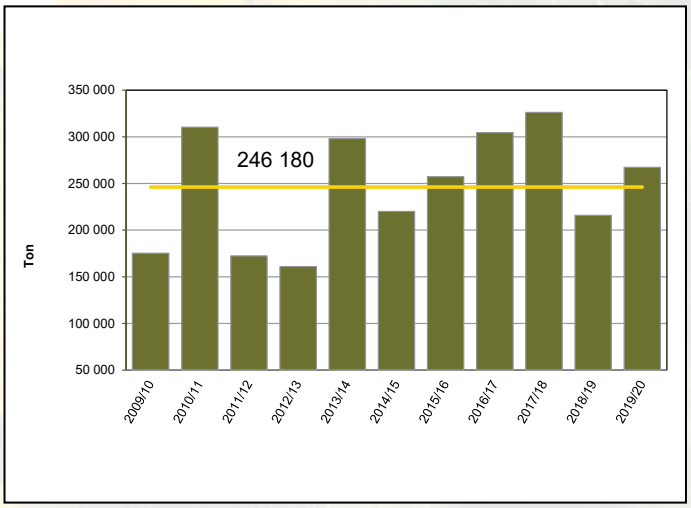
Graph 6: Sunflower production in the Free State since 2009/10



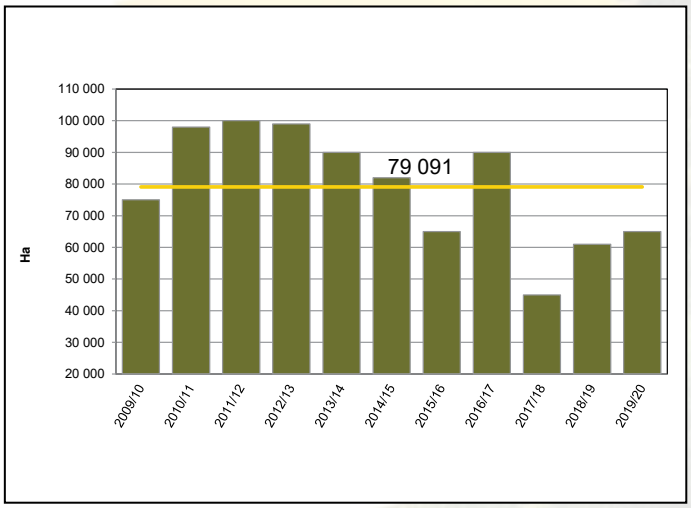
Graph 7: Area utilised for sunflower production in North West since 2009/10



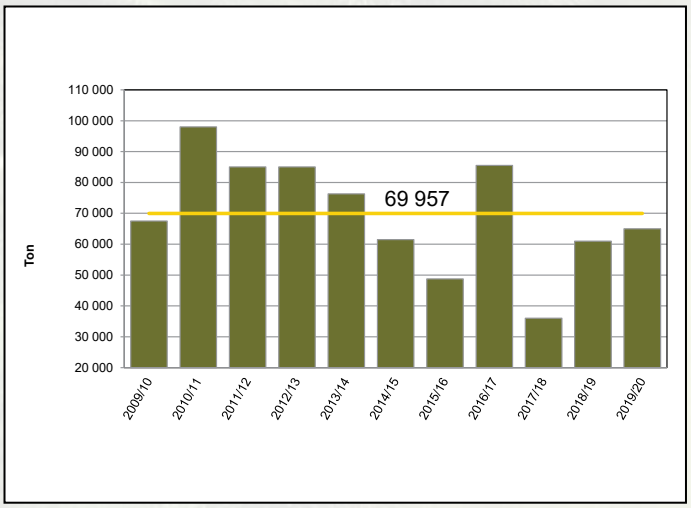
Graph 8: Sunflower production in North West since 2009/10



Graph 9: Area utilised for sunflower production in Limpopo since 2009/10



Graph 10: Sunflower production in Limpopo since 2009/10



Figures provided by the CEC.

Eleven season average

Supply and Demand

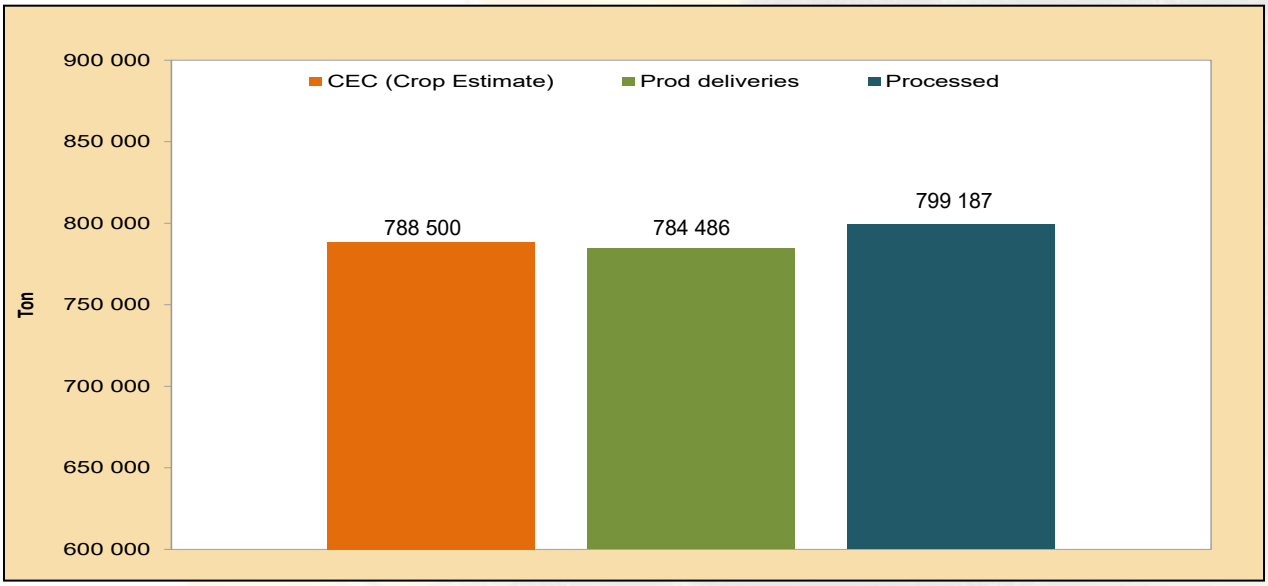
The sunflower seed marketing season dates from March to February. According to SAGIS supply and demand figures for the 2020/21 marketing season to date (March 2020 to January 2021), opening stock increased by almost 13% compared to the previous marketing season and exceeds the 10-year average by 37% (36 295 tons).

To date, 373 tons of sunflower and sunflower seed products have been imported compared to the 457 and 1 324 tons of the previous two seasons respectively. The 10-year import average is 35 163 tons. Of the 799 187 tons of sunflower seeds processed so far, only 1 532 tons (0.2%) was used for human consumption and 5 048 tons (0.6%) for animal feed. The vast majority of sunflower seed is crushed to produce oil and oilcake. The amount of sunflower seeds crushed to date is almost 21% more than in the previous season and also 7% more than the 10-year average of 738 178 tons.

According to *BFAP Baseline*, vegetable oil consumption increased by 43% over the past 10 years but is however projected to increase by only 10% over the coming decade. Being a higher value food product, edible oil demand is sensitive to changes in consumer spending power. Over the short term, consumption is projected to decline, before recovering from 2022 onwards. Between 2007 and 2009 to 2019, sunflower oil consumption increased by 41%. This growth is projected to slow to 17% by 2029, relative to the 2017-2019 base period.

Exports to date amount to 499 tons, compared to the 576 tons of the 2019/20 season. Globally, Russia, followed by Argentina and the Ukraine were the largest exporters of sunflower seeds during 2019/20. The United States was only the fourth largest exporter during this season. The Ukraine (6.8 million metric tons) and Russia (3.7 million metric tons) accounted for 78% of total sunflower oil exports worldwide in the corresponding period *(National Sunflower Association website www.sunflowernsa.com, Table updated January 12, 2021; Source: Oil World & USDA).*

Graph 11: Sunflower supply and demand overview for the current marketing season (Mar 2020 - Feb 2021)



Information provided by SAGIS.

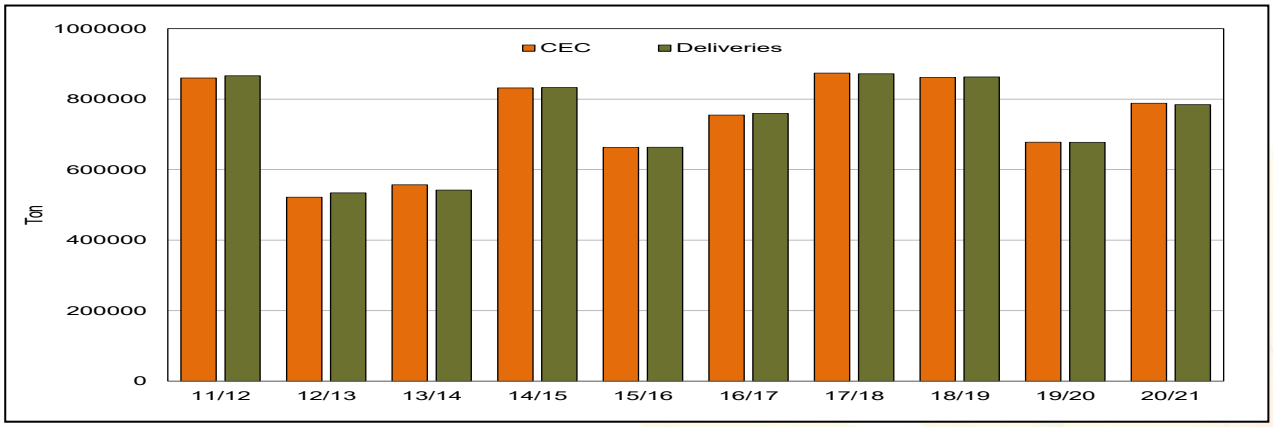
SAGIS South African Grain Information Service
Suid-Afrikaanse Graan Inligtingsdiens

SUNFLOWERSEED: SUPPLY AND DEMAND TABLE BASED ON SAGIS' INFO (TON) — **Publication date: 2021-02-25**

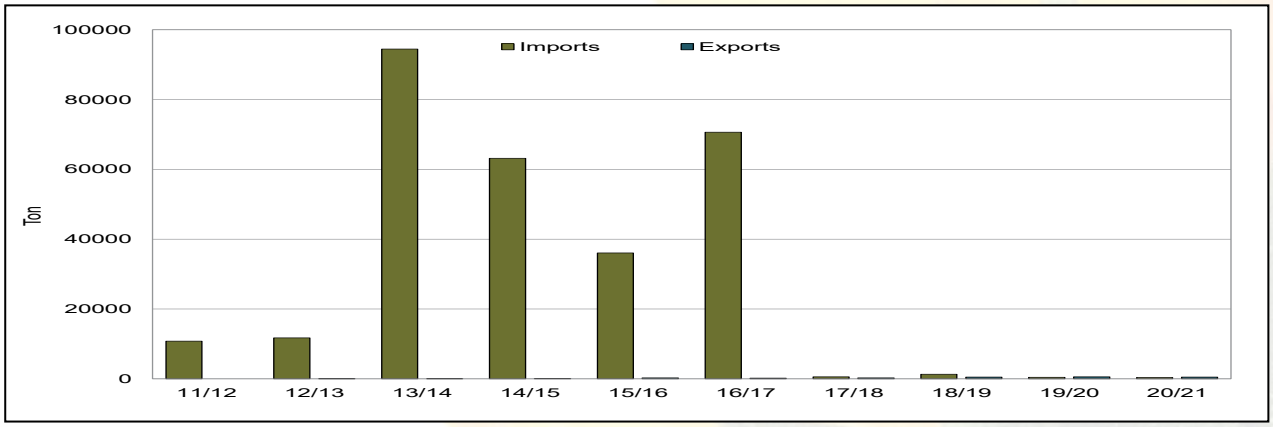
	Season (Mar - Feb)																Current Season Mar-Jan	10 Year average
	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	2010/11-2019/20
																	***	
																	11	
CEC (Crop Estimate)	648 000	620 000	520 000	300 000	872 000	801 000	490 000	860 000	522 000	557 000	832 000	663 000	755 000	874 000	862 000	678 000	788 500	709 300
SUPPLY																		
Opening stock (1 Mar)	41 300	69 900	40 700	90 400	64 700	164 300	157 200	18 800	109 000	81 302	47 116	92 927	45 867	163 086	154 841	120 165	135 325	99 030
Prod deliveries	652 900	612 700	524 900	310 100	846 600	806 900	477 300	866 300	534 251	542 165	833 165	663 669	759 614	872 171	863 184	677 674	784 486	708 949
Imports	300	5 900	3 100	8 900	25 600	45 300	62 400	10 800	11 737	94 475	63 180	36 064	70 643	554	1 324	457	373	35 163
Surplus	0	3 800	2 300	1 500	4 100	700	2 000	3 800	5 485	4 689	5 948	9 897	4 268	12 173	6 863	6 520	7 060	6 164
Total Supply	**694 500**	**692 300**	**571 000**	**410 900**	**941 000**	**1 017 200**	**698 900**	**899 700**	**660 473**	**722 631**	**949 409**	**802 557**	**880 392**	**1 047 984**	**1 026 212**	**804 816**	**927 244**	**849 307**
DEMAND																		
Processed	616 900	644 300	472 300	339 500	685 300	847 200	671 500	782 200	572 519	666 551	847 682	747 808	707 327	885 039	900 045	664 027	799 187	744 470
-human	700	1 300	1 200	2 100	2 400	1 900	1 600	1 300	904	1 162	467	1 003	1 192	1 487	1 609	1 478	1 532	1 220
-animal feed	3 200	2 600	3 100	3 500	3 400	3 300	3 100	2 900	3 022	2 777	2 893	8 995	10 665	5 737	5 114	5 511	5 048	5 071
-crush (oil and oilcake)	613 000	640 400	468 000	333 900	679 500	842 000	666 800	778 000	568 593	662 612	844 322	737 810	695 470	877 815	893 322	657 038	792 607	738 178
Withdrawn by producers	2 700	1 500	2 000	1 900	4 900	5 700	1 700	3 500	2 521	2 524	1 068	1 157	605	442	519	783	440	1 482
Released to end-consumers	2 400	2 700	3 500	3 000	2 800	4 800	4 100	3 700	3 154	2 923	2 799	2 936	2 867	2 592	1 764	1 023	1 040	2 786
Seed for planting purposes	1 300	2 200	1 200	1 800	3 300	2 700	1 700	2 500	2 700	2 903	3 804	2 824	3 474	3 026	3 582	2 447	2 493	2 896
Net receipts(-)/disp(+)	- 2 000	900	1 500	0	1 000	- 400	1 000	- 1 200	- 1 716	606	1 081	1 709	2 828	1 770	- 378	635	1 379	634
Deficit	3 100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exports	200	0	100	0	79 400	0	100	0	27	8	48	256	205	274	515	576	499	201
Total Demand	**624 600**	**651 600**	**480 600**	**346 200**	**776 700**	**860 000**	**680 100**	**790 700**	**579 205**	**675 515**	**856 482**	**756 690**	**717 306**	**893 143**	**906 047**	**669 491**	**805 038**	**752 468**
Ending Stock (28 Feb)	**69 900**	**40 700**	**90 400**	**64 700**	**164 300**	**157 200**	**18 800**	**109 000**	**81 268**	**47 116**	**92 927**	**45 867**	**163 086**	**154 841**	**120 165**	**135 325**	**122 206**	**96 840**
- processed p/month	51 400	53 700	39 400	28 300	57 100	70 600	65 000	65 200	47 700	55 546	70 640	62 317	58 944	73 753	75 004	55 336	72 653	62 944
- months' stock	1.4	0.8	2.3	2.3	2.9	2.2	0.3	1.7	1.7	0.8	1.3	0.7	2.8	2.1	1.6	2.4	1.7	1.5

Note: *** Figures for current season up to date

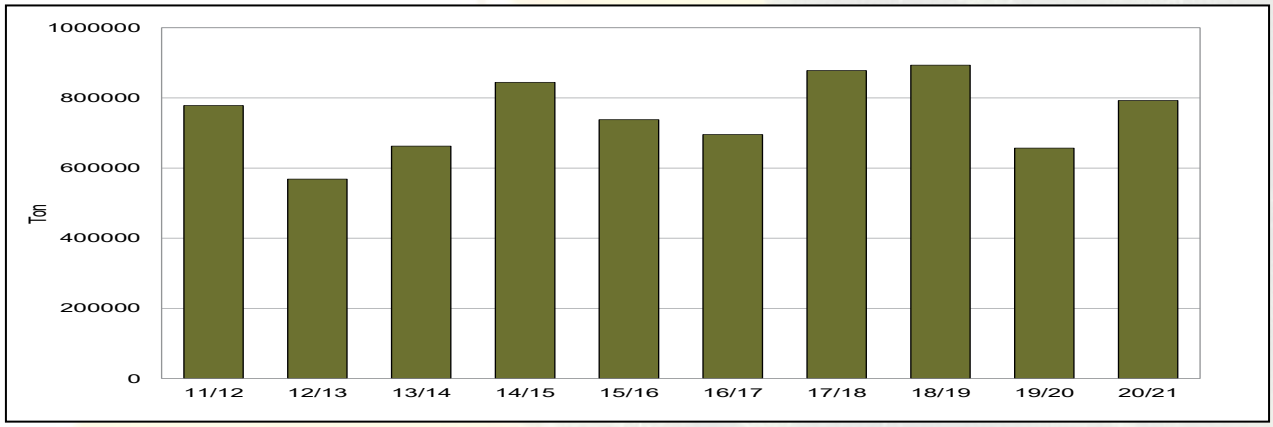
Graph 12: Sunflower: CEC Estimate vs SAGIS deliveries over 10 marketing seasons



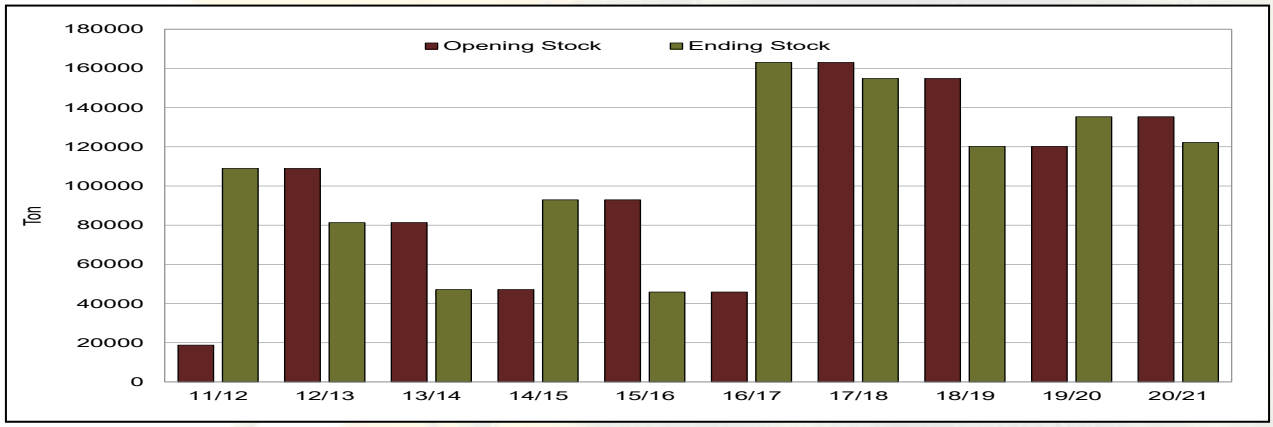
Graph 13: Sunflower: Imports and Exports over 10 marketing seasons



Graph 14: Sunflower: Crushed over 10 marketing seasons



Graph 15: Sunflower: 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 SUNFLOWER: IMPORTS FOR RSA PER COUNTRY												
	Argentina	Botswana	Brazil	Bulgaria	China	Egypt	Malawi	Mozam-bique	Romania	Ukraine	United Kingdom	Zambia	Total
2015/16	80	4 518	0	0	0	0	663	0	30 531	0	0	272	36 064
2016/17	42	1 424	0	38 434	0	0	686	0	30 015	19	23	0	70 643
2017/18	21	0	0	0	18	44	429	19	0	0	23	0	554
2018/19	65	381	0	0	0	23	855	0	0	0	0	0	1 324
2019/20	44	0	0	0	0	23	390	0	0	0	0	0	457
2020/21	65	0	20	0	0	67	221	0	0	0	0	0	373

Season	SUNFLOWER: IMPORTS PER HARBOUR					
	Harbours					
	East London	Durban	Cape	Port Elizabeth	Richards Bay	Total
2006/07	0	0	0	0	0	0
2007/08	0	19	0	0	0	19
2008/09	0	0	0	0	0	0
2009/10	0	66 547	0	0	0	66 547
2010/11	0	50 209	0	0	0	50 209
2011/12	0	0	0	0	0	0
2012/13	0	0	0	0	0	0
2013/14	0	92 832	0	0	0	92 832
2014/15	0	57 842	0	0	0	57 842
2015/16	0	30 611	0	0	0	30 611
2016/17	0	68 533	0	0	0	68 533
2017/18	0	44	62	0	0	106
2018/19	0	88	0	0	0	88
2019/20	0	67	0	0	0	67
2020/21*	0	87	65	0	0	152

* Progressive March 2020 - January 2021
Note: Includes Imports for RSA and Other Countries

Season	WHOLE SUNFLOWER: RSA EXPORTS PER COUNTRY					
	Australia	Botswana	Namibia	Eswatini	Zimbabwe	Total
2015/16	0	10	158	88	0	256
2016/17	0	40	48	107	10	205
2017/18	0	23	136	115	0	274
2018/19	0	10	360	145	0	515
2019/20	0	95	341	140	0	576
2020/21	0	16	291	192	0	499

Season	SUNFLOWER: EXPORTS PER HARBOUR					
	Harbours					
	East London	Durban	Cape	Port Elizabeth	Richards Bay	Total
2006/07	0	0	0	0	0	0
2007/08	0	0	0	0	0	0
2008/09	34 870	44 555	0	0	0	79 425
2009/10	0	0	0	0	0	0
2010/11	0	0	0	0	0	0
2011/12	0	0	0	0	0	0
2012/13	0	0	0	0	0	0
2013/14	0	0	0	0	0	0
2014/15	0	22	0	0	0	22
2015/16	0	0	0	0	0	0
2016/17	0	0	0	0	0	0
2017/18	0	0	0	0	0	0
2018/19	0	0	0	0	0	0
2019/20	0	0	0	0	0	0
2020/21*	0	0	0	0	0	0

* Progressive March 2020 - January 2021
All figures are reported in Tons

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

	OIL SEEDS PRODUCTS PER MONTH MANUFACTURED													
	Marketing year Mar 2018 - Feb 2019 Progressive: 12 Months	**Marketing year Mar 2019 - Feb 2020** Progressive: 12 Months	**Mar 2020** Manufactured Tons	**Apr 2020** Manufactured Tons	**May 2020** Manufactured Tons	**Jun 2020** Manufactured Tons	**Jul 2020** Manufactured Tons	**Aug 2020** Manufactured Tons	**Sep 2020** Manufactured Tons	**Oct 2020** Manufactured Tons	**Nov 2020** Manufactured Tons	**Dec 2020** Manufactured Tons	**Jan 2021** Manufactured Tons	**Market-ing year Mar 2020 - Feb 2021** Progressive: 11 Months
Palm Oil and Derivatives	**0**	**0**	0	0	0	0	0	0	0	0	0	0	0	**0**
Soybean Oil	**180 325**	**220 307**	17 921	17 819	21 620	19 795	17 070	16 395	22 377	20 075	17 283	15 525	12 175	**198 055**
Sunflower Oil	**315 406**	**234 557**	17 896	13 828	25 570	28 315	28 375	28 484	28 410	33 509	33 930	25 941	19 781	**284 039**
Coconut Oil/ Groundnut Oil / Canola Oil / Corn (Maize) Oil / Blends or mixes of Oils which includes one of the above Oils / Biodiesel / Cottonseed Oil	**51 780**	**47 910**	3 581	3 249	3 472	4 608	3 610	4 161	3 103	4 650	5 523	4 112	4 261	**44 330**
Sunflower Oilcake	**379 395**	**276 766**	20 422	17 956	29 362	32 723	33 257	31 432	31 410	36 909	38 350	28 973	24 563	**325 357**
Coconut Oilcake	**0**	**0**	0	0	0	0	0	0	0	0	0	0	0	**0**
Palmnut Oilcake	**0**	**0**	0	0	0	0	0	0	0	0	0	0	0	**0**
Soybean Oilcake / Canola Oilcake / Cottonseed Oilcake	**847 062**	**1 022 415**	76 838	77 603	98 410	93 328	80 868	84 658	102 121	95 313	83 197	75 556	59 870	**927 762**
Soybean Flours and Meals / Textured Vegetable Protein	**38 779**	**39 785**	3 941	3 676	3 809	3 779	3 544	3 445	3 397	3 357	2 263	1 307	2 771	**35 289**
Soybean Fullfat	**224 233**	**194 228**	14 285	12 396	13 687	14 375	14 749	13 586	15 321	13 173	10 780	8 924	9 130	**140 406**
Peanut Butter and Paste	**29 734**	**28 026**	3 099	2 828	3 261	3 305	2 945	3 110	3 915	3 475	3 181	2 655	2 589	**34 363**
Total	**2 066 714**	**2 063 994**	**157 983**	**149 355**	**199 191**	**200 228**	**184 418**	**185 271**	**210 054**	**210 461**	**194 507**	**162 993**	**135 140**	**1 989 601**

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

	OIL SEEDS PRODUCTS PER MONTH IMPORTED													
	Marketing year Mar 2018 - Feb 2019 Progressive: 12 Months	**Marketing year Mar 2019 - Feb 2020** Progressive: 12 Months	**Mar 2020** Manufactured Tons	**Apr 2020** Manufactured Tons	**May 2020** Manufactured Tons	**Jun 2020** Manufactured Tons	**Jul 2020** Manufactured Tons	**Aug 2020** Manufactured Tons	**Sep 2020** Manufactured Tons	**Oct 2020** Manufactured Tons	**Nov 2020** Manufactured Tons	**Dec 2020** Manufactured Tons	**Jan 2021** Manufactured Tons	**Market-ing year Mar 2020 - Feb 2021** Progressive: 11 Months
Palm Oil and Derivatives	**536 957**	**534 456**	52 663	42 626	44 007	37 715	48 105	42 488	46 811	51 691	35 277	63 920	18 697	**484 000**
Soybean Oil	**116 828**	**90 934**	8 995	4 300	12 486	12 598	5 000	14 504	5 000	13 938	13 150	13 388	9 920	**113 279**
Sunflower Oil	**143 635**	**244 099**	18 931	14 862	14 914	2 524	18 060	32 716	7 199	947	11 969	6 011	6 200	**134 333**
Coconut Oil/ Groundnut Oil / Canola Oil / Corn (Maize) Oil / Blends or mixes of Oils which includes one of the above Oils / Biodiesel / Cottonseed Oil	**15 891**	**14 386**	999	1 232	3 033	1 153	600	40	1 163	777	1 084	938	805	**11 824**
Sunflower Oilcake	**48 777**	**118 791**	0	6 783	0	0	0	0	0	0	0	0	0	**6 783**
Coconut Oilcake	**0**	**0**	0	0	0	0	0	0	0	0	0	0	0	**0**
Palmnut Oilcake	**0**	**0**	0	0	0	0	0	0	0	0	0	0	0	**0**
Soybean Oilcake / Canola Oilcake / Cottonseed Oil-cake	**358 850**	**463 478**	11 028	55 828	32 525	6 916	58 780	19 087	17 018	73 154	30 148	57	50 318	**354 859**
Soybean Flours and Meals / Textured Vegetable Pro-tein	**0**	**0**	0	0	0	0	0	0	0	0	0	0	0	**0**
Soybean Fullfat	**0**	**0**	0	0	0	0	0	0	0	0	0	0	0	**0**
Peanut Butter and Paste	**1 035**	**1 391**	148	110	54	0	195	75	0	0	265	197	55	**1 099**
Total	**1 221 973**	**1 467 535**	92 764	125 741	107 019	60 906	130 740	108 910	77 191	140 507	91 893	84 511	85 995	**1 106 177**

SAGIS South African Grain Information Service NPC
Suid Afrikaanse Graaninligtingsdiens NWM
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	OIL SEEDS PRODUCTS PER MONTH EXPORTED													
	Marketing year Mar 2018 - Feb 2019 Progressive: 12 Months	**Marketing year Mar 2019 - Feb 2020** Progressive: 12 Months	**Mar 2020** Manufactured Tons	**Apr 2020** Manufactured Tons	**May 2020** Manufactured Tons	**Jun 2020** Manufactured Tons	**Jul 2020** Manufactured Tons	**Aug 2020** Manufactured Tons	**Sep 2020** Manufactured Tons	**Oct 2020** Manufactured Tons	**Nov 2020** Manufactured Tons	**Dec 2020** Manufactured Tons	**Jan 2021** Manufactured Tons	**Marketing year Mar 2020 - Feb 2021** Progressive: 11 Months
Palm Oil and Derivatives	**15 771**	**16 078**	948	647	1 066	1 656	1 647	1 236	1 396	1 027	785	821	633	**11 862**
Soybean Oil	**29 459**	**17 619**	2 978	6 523	7 047	3 538	3 819	2 847	4 313	1 268	1 806	2 253	5 786	**42 178**
Sunflower Oil	**2 169**	**3 067**	150	70	227	271	464	434	588	254	281	234	136	**3 109**
Coconut Oil/ Groundnut Oil / Canola Oil / Corn (Maize) Oil / Blends or mixes of Oils which includes one of the above Oils / Biodiesel / Cottonseed Oil	**977**	**933**	451	288	228	791	369	876	911	544	577	720	316	**6 071**
Sunflower Oilcake	**3 464**	**3 006**	98	135	160	160	170	136	130	100	102	100	150	**1 441**
Coconut Oilcake	**0**	**0**	0	0	0	0	0	0	0	0	0	0	0	**0**
Palmnut Oilcake	**0**	**0**	0	0	0	0	0	0	0	0	0	0	0	**0**
Soybean Oilcake / Canola Oilcake / Cottonseed Oilcake	**11 420**	**10 520**	1 131	588	879	907	1 117	697	1 020	1 751	1 348	1 096	246	**10 780**
Soybean Flours and Meals / Textured Vegetable Protein	**1 802**	**4 108**	235	262	375	0	204	204	918	646	703	578	870	**4 995**
Soybean Fullfat	**7 120**	**2 723**	196	235	163	34	204	96	272	544	298	164	335	**2 541**
Peanut Butter and Paste	**821**	**274**	26	27	23	16	23	19	19	17	24	2	12	**208**
Total	**73 003**	**58 328**	6 213	8 775	10 168	7 373	8 017	6 545	9 567	6 151	5 924	5 968	8 484	**83 185**

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.

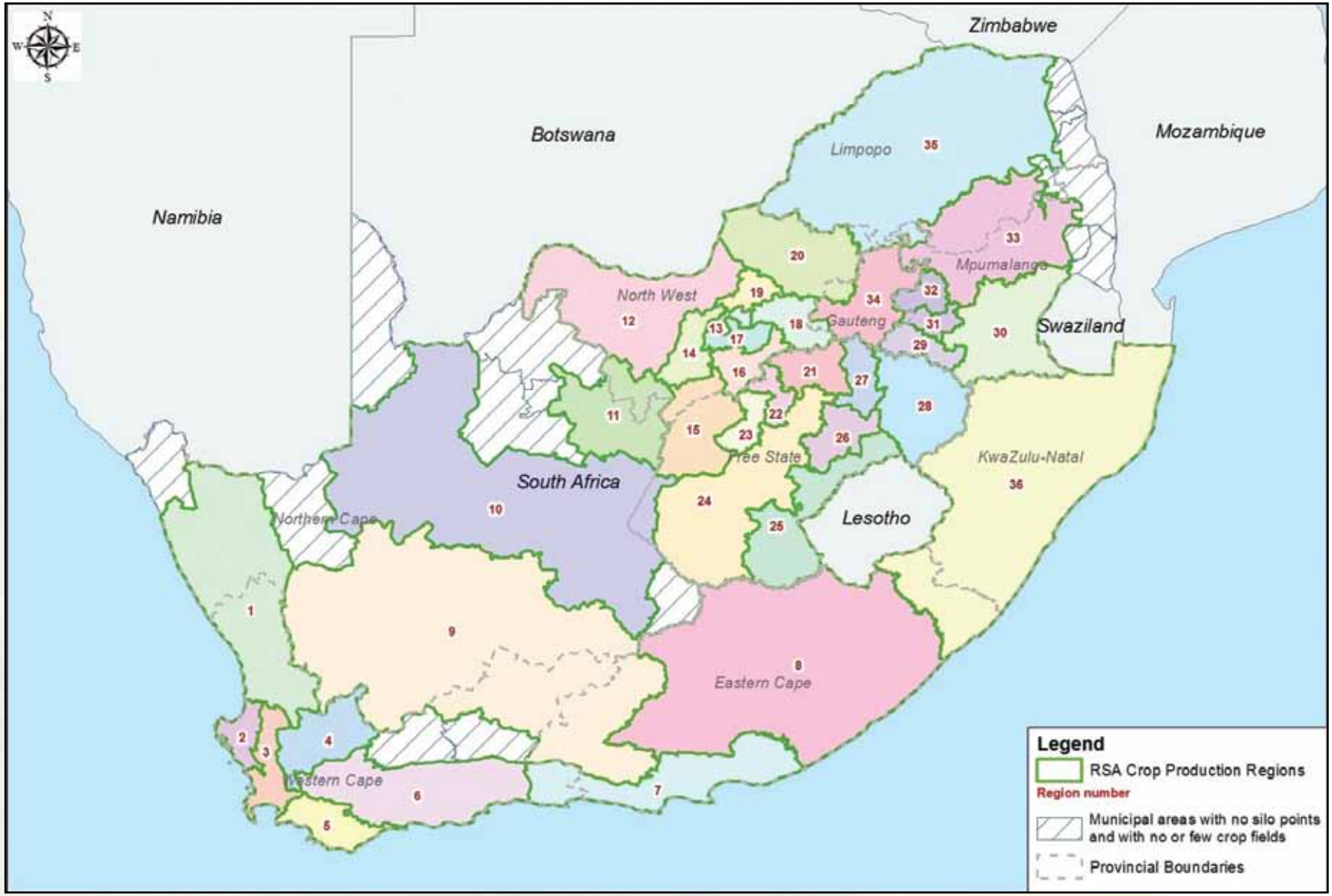
The 9 provinces are divided into 36 grain production regions.

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 sunflower samples have been received for the crop quality survey of the 2019/20 production season, are named and described on pages 15 to 17. 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.

Grain Production Regions

Silo/Intake stands per region indicating type of storage structure

Region 12: North West Western Region			
NWK	Blaauwbank (Bins)	NWK	Mareetsane (Bins)
NWK	Bührmannsdrif (Bins)	Suidwes Landbou	Kameel (Bins)
NWK	Kameel (Bins)	Suidwes Landbou	Vryburg (Bins)

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

Region 14: North West Southern Region			
NWK	Barberspan (Bins)	NWK	Taaibospan (Bins)
NWK	Delareyville (Bins)	Suidwes Landbou	Amalia (Bins)
NWK	Excelsior (Bins)	Suidwes Landbou	Hallatshope (Bins)
NWK	Geysdorp (Bins)	Suidwes Landbou	Migdol (Bins)
NWK	Migdol (Bins)	Suidwes Landbou	Schweizer-Reneke (Bins)
NWK	Nooitgedacht (Bins)		

Region 15: North West South-Eastern Region			
Suidwes Landbou	Bloemhof (Bins)	Suidwes Landbou	Kingswood (Bins)
Suidwes Landbou	Christiana (Bins)	Suidwes Landbou	Kruising (Bunkers)
Suidwes Landbou	Hertzogville (Bins)	Suidwes Landbou	Poppieland (Bunkers)
Suidwes Landbou	Hoopstad (Bins)		

Region 16: North West Central-Eastern Region			
Senwes	Klerksdorp (Bins)	Suidwes Landbou	Makwassie (Bins)
Senwes	Regina (Bins)	Suidwes Landbou	Strydpoort (Bins)
Suidwes Landbou	Bamboesspruit (Bins)	Suidwes Landbou	Wolmaranstad (Bins)
Suidwes Landbou	Leeudoringstad (Bins)		

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)

Grain Production Regions

Silo/Intake stands per region indicating type of storage structure

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 22: Free State North-Western Region (Bothaville)			
Senwes	Allanrigde (Bins)	Senwes	Schoonspruit (Bins)
Senwes	Bothaville (Bins)	Senwes	Schuttesdraai (Bins)
Senwes	Mirage (Bins)	Suidwes	Misgunst (Bunkers)
Senwes	Odendaalsrus (Bins)		

Region 23: Free State North-Western Region (Bultfontein)			
Senwes	Bultfontein (Bins)	Senwes	Tierfontein (Bins)
Senwes	Losdoorns (Bins)	Senwes	Wesselsbron (Bins)
Senwes	Protespan (Bins)	Senwes	Willemsrus (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)		

Region 25: Free State South-Western Region			
Afgri	Bethlehem (Bins)	OVK	Marseilles (Bins)
Afgri	Slabberts (Bins)	OVK	Modderpoort (Bins)
OVK	Clocolan (Bins)	OVK	Tweespruit (Bins)
OVK	Ficksburg (Bins)	OVK	Westminster (Bins)
OVK	Fouriesburg (Bins)		

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)

Grain Production Regions

Silo/Intake stands per region indicating type of storage structure

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 28: Free State Eastern Region			
Afgri	Afrikaskop (Bins/Bunkers)	VKB	Jim Fouché (Bins)
Afgri	Eeram (Bins)	VKB	Memel (Bins)
Afgri	Harrismith (Bins)	VKB	Reitz (Bins)
Afgri	Kransfontein (Bins/Bunkers)	VKB	Tweeling (Bins)
VKB	Ascent (Bins)	VKB	Villiers (Bins/Bulk)
VKB	Cornelia (Bins)	VKB	Vrede (Bins)
VKB	Daniëlsrus (Bins)	VKB	Warden (Bins)
VKB	Frankfort (Bins)	VKB	Windfield (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 34: Gauteng Region			
Afgri	Bloekomspruit (Bins)	Afgri	Nigel (Bins)
Afgri	Bronkhorstspruit (Bins)	Afgri	Pretoria Wes (Bins)
Afgri	Glenroy (Bins)	Afgri	Vogelvallei (Bunkers)
Afgri	Goeie Hoek (Bins)	Senwes	Middelvlei (Bins)
Afgri	Kaalfontein (Bins)	Senwes	Oberholzer (Bins)
Afgri	Kliprivier (Bunkers)	Senwes	Raathsvlei (Bins)
Afgri	Meyerton (Bunkers)		

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)

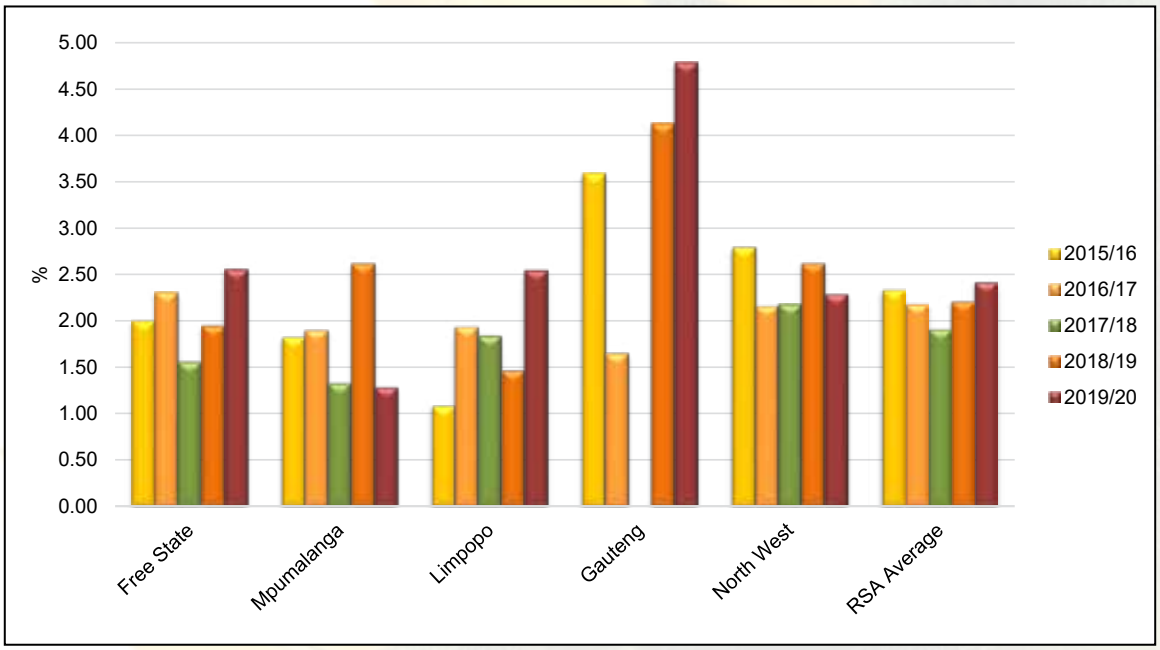
Sunflower Crop Quality 2019/20 – Summary of results

Sixty-three percent (111) of the 176 samples analysed for the purpose of this survey were graded as Grade FH1, with 65 of the samples downgraded to COSF (Class Other Sunflower Seed). This is the highest percentage (37%) of samples downgraded to Class Other since commencement of the sunflower crop surveys in 2012/13. Last season's percentage, namely 24%, was the second highest in the history of the crop surveys.

- Nineteen (29%) of the samples were downgraded as a result of the percentage of either the screenings or the collective deviations or a combination of both exceeding the maximum permissible deviations of 4% and 6% respectively.
- Five samples (8%) were downgraded due to the percentage damaged sunflower seeds exceeding the maximum permissible deviation of 10% as well as presence of a sour odour.
- Fifteen samples in total (23%) were downgraded as a result of the presence of poisonous seeds. Thirteen samples were downgraded due to the presence of *Datura sp*. and one sample due to *Crotalaria sp*. exceeding the maximum permissible number, namely 1 per 1000 g. Another sample was downgraded due to *Xanthium strumarium* (cocklebur) seeds exceeding 7 per 1000 g.
- The remaining 40% (26) samples were downgraded as a result of a combination of one or more of the following deviations exceeding the maximum permissible deviation: damaged sunflower seeds, screenings, sclerotia, foreign matter, collective deviations as well as the presence of poisonous seeds (*Datura spp*.) or an musty odour.

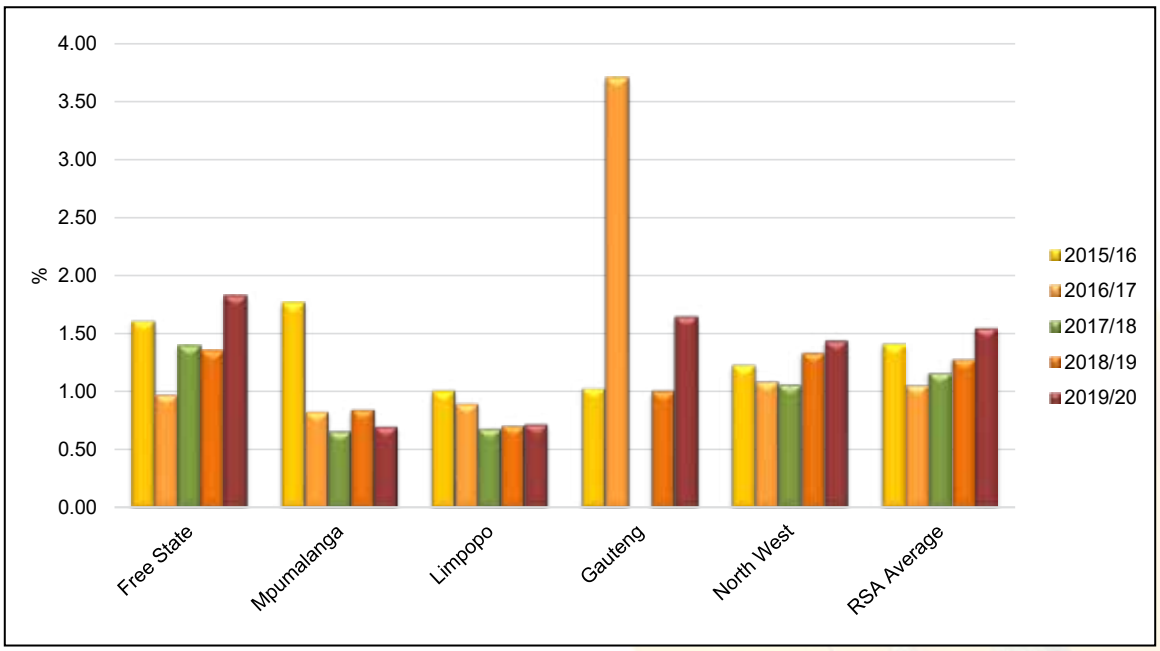
The sample from Gauteng province reported the highest average percentage screenings namely 4.79%, followed by the Free State (N = 84) and Limpopo (N = 13) with 2.56% and 2.55% respectively. North West province (N = 72) averaged 2.29% and Mpumalanga's six samples the lowest percentage screenings of 1.29%. The weighted national average was 2.42% compared to the 2.21% of the previous season.

Graph 16: Average percentage screenings per province over five seasons



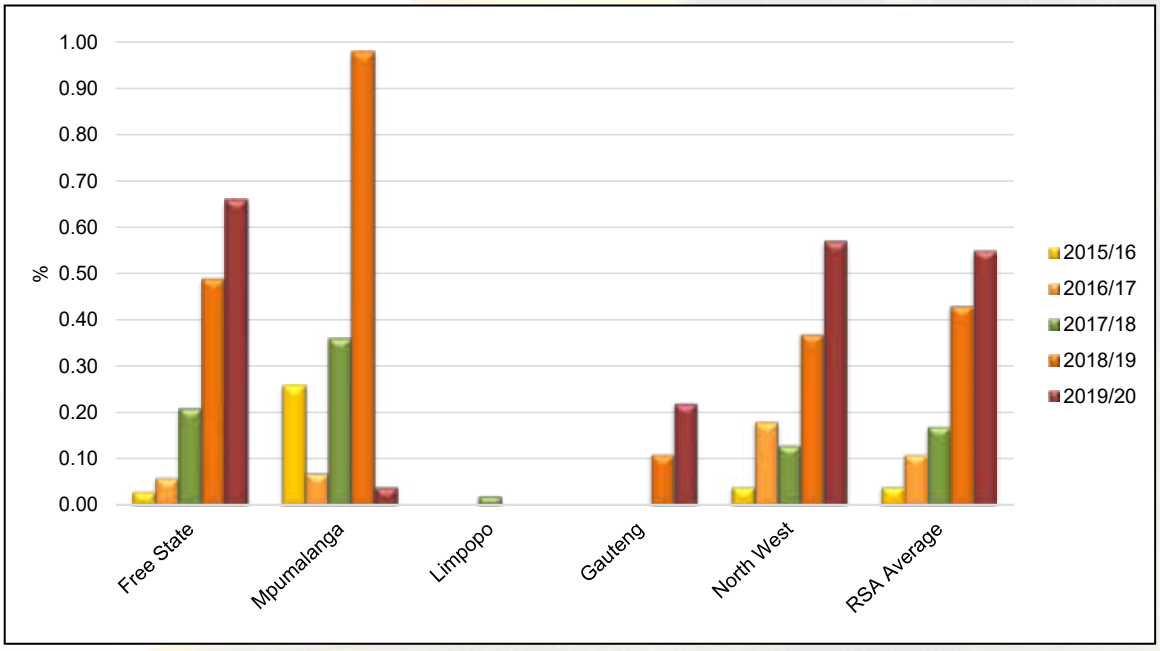
The highest weighted average percentage foreign matter (1.83%) was reported for the Free State provinces' regions. Gauteng and North West followed with 1.65% and 1.44% respectively. The lowest percentages were found in Mpumalanga with 0.70% and Limpopo with 0.72%. The South African average was 1.55% compared to the 1.28% and 1.16% of the previous two seasons. This season's average was also the highest reported since commencement of these crop surveys in the 2012/13 season. Please see Graph 17.

Graph 17: Average percentage foreign matter per province over five seasons



The number of samples received for this survey that contained sclerotia from the fungus *Sclerotinia sclerotiorum*, increased from 90 samples (51%) in the previous season, to 125 samples (71%) this season. 54% of these samples originated in the Free State province and 45% in North West. Single samples from Mpumalanga and Gauteng also reported sclerotia. Two samples (both from the Free State region) exceeded the maximum permissible deviation of 4%. Weighted average levels ranged from 0% in Limpopo to 0.57% in North West and 0.66% in the Free State. The national average of 0.55%, is the highest since the 0.53% of the 2013/14 season. Last season's average was 0.43%.

Graph 18: Average percentage sclerotia per province over five seasons

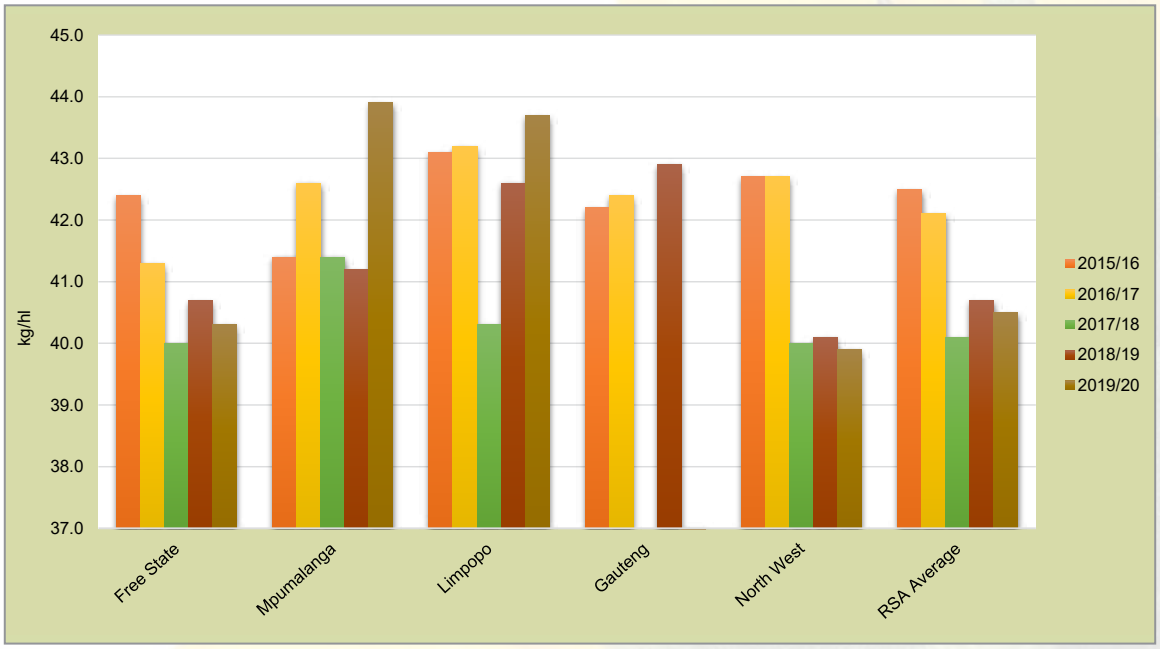


Test weight does not form part of the grading regulations for sunflower seed in South Africa. An approximation of the test weight of South African sunflower seed is provided in Table 3 for information purposes. The standard working procedure of the Kern 222 instrument, as described in ISO 7971-3:2019, was followed. The g/1 L filling mass of the sunflower seed samples was determined and divided by two. The test weight was then extrapolated by means of the following formulas obtained from the Test Weight Conversion Chart for Sunflower Seed, Oil of the Canadian Grain Commission: $y = 0.1936x + 2.2775$ (138 to 182 g/0.5 L) and $y = 0.1943x + 2.1665$ (183 to 227 g/0.5 L). Please also see Graph 19 for a comparison of the test weight per province over the last five seasons.

Table 3: Approximation of test weight per province over three seasons									
Province	Test weight, kg/hl								
	2019/20 Season			2018/19 Season			2017/18 Season		
	Weighted average	Range	No. of samples	Weighted average	Range	No. of samples	Weighted average	Range	No. of samples
Free State (Regions 21 - 28)	40.3	27.3 - 47.3	84	40.7	33.1 - 46.8	95	40.0	34.9 - 45.7	64
Mpumalanga (Regions 29 - 33)	43.9	43.7 - 44.0	6	41.2	39.8 - 42.8	8	41.4	35.0 - 42.2	8
Limpopo (Region 35)	43.7	38.7 - 47.4	13	42.6	37.8 - 45.4	12	40.3	38.5 - 43.1	5
Gauteng (Region 34)	34.2	-	1	42.9	42.5 - 43.6	3	-	-	-
North West (Region 12 - 20)	39.9	30.9 - 48.4	72	40.1	30.9 - 46.5	58	40.0	33.2 - 45.9	*98
RSA	***40.5***	***27.3 - 48.4***	***176***	***40.7***	***30.9 - 46.8***	***176***	***40.1***	***33.2 - 45.9***	***175***

**One sample with an outlier value was not taken into account for calculation purposes.*

Graph 19: Comparison of the test weight per province over five seasons



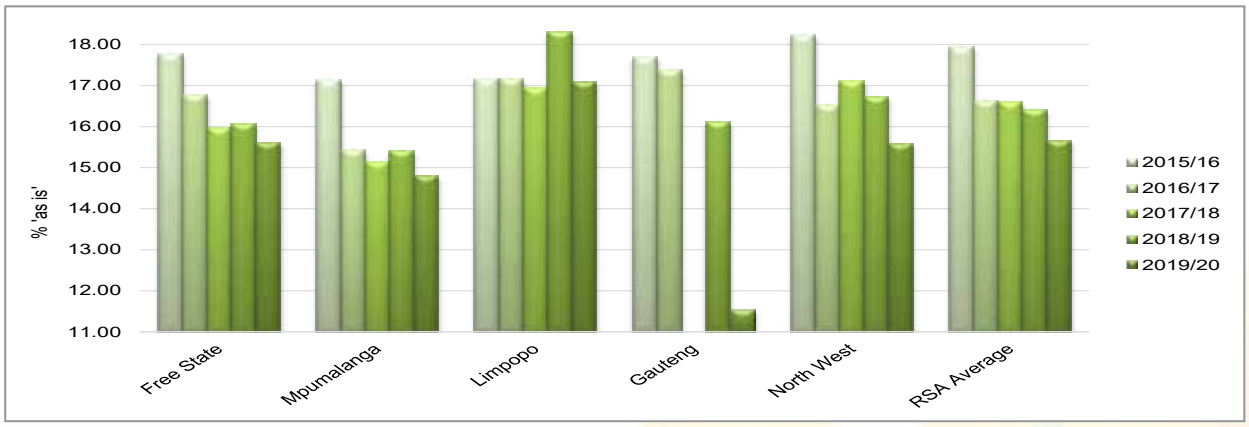
The nutritional component analyses, namely crude protein, -fat, -fibre and ash are reported as % (g/100 g) on an 'as received' or 'as is' basis.

The weighted average crude protein content this season was 15.66% and the lowest of the eight seasons for which crop survey results are available. The previous season's average was 16.40%. Limpopo had the highest weighted average crude protein content of 17.08%, followed by the Free State and North West with 15.61% and 15.58% respectively. Mpumalanga averaged 14.79%, while the single sample from Gauteng reported the lowest average of 11.54%. The weighted average crude fat percentage was 38.7%, the highest of the last five seasons and almost one percent higher than last season's 37.9%. Mpumalanga had the highest weighted average crude fat content of 39.7%, followed by North West with 39.2%. The lowest average fat content was the 35.6% of the sample from Gauteng.

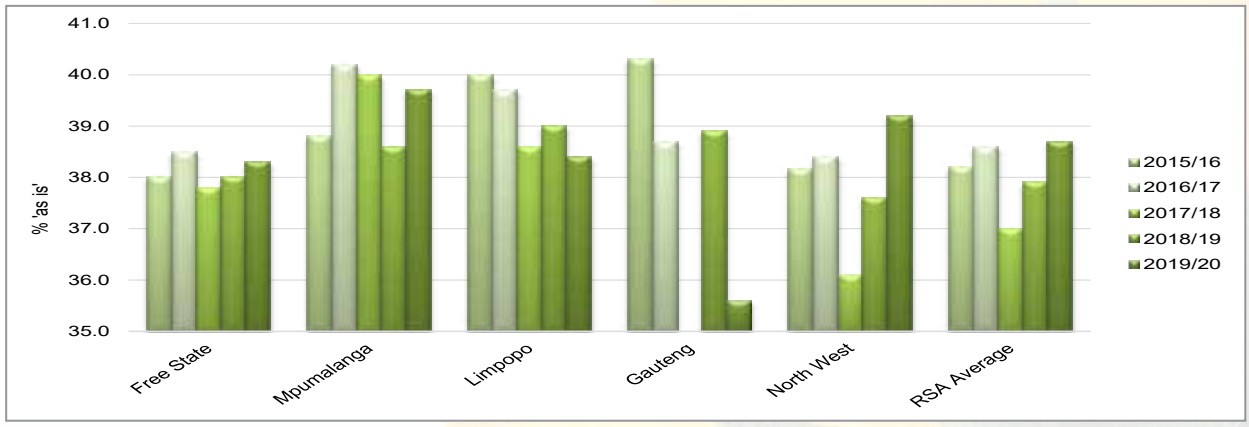
The weighted average percentage crude fibre was the second highest of the last eight seasons, equaling the 21.9% of the 2017/18 season. The highest average was reported in 2018/19, namely 22.4%. Average values varied between 20.1% in Limpopo to 25.4% in Gauteng. The weighted average ash content was 2.65%, slightly higher than the 2.60% of the previous season. The provincial averages ranged from 2.21% in Mpumalanga to 2.71% in Gauteng.

Graphs 20 to 23 on page 21 provide comparisons between provinces and over seasons for the nutritional components discussed above.

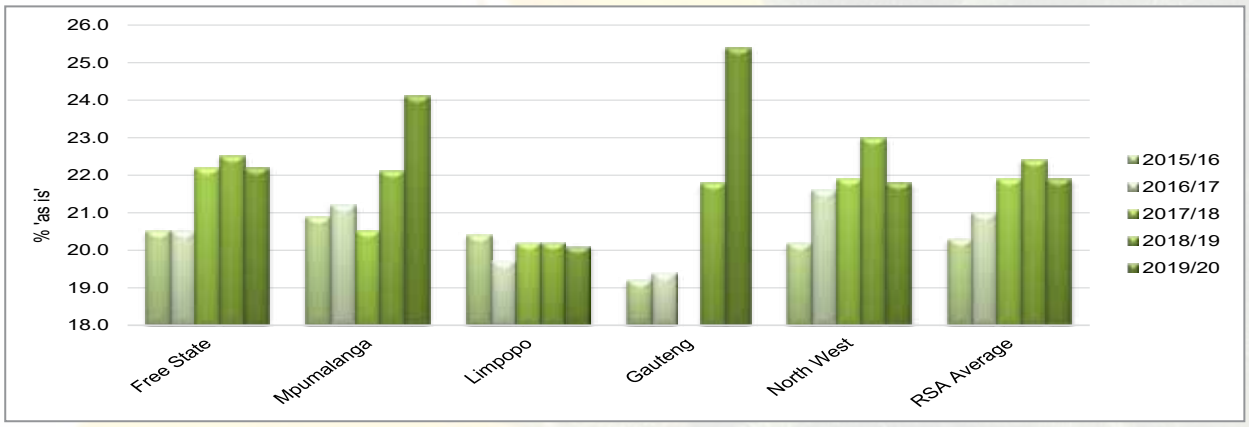
Graph 20: Average crude protein content per province over five seasons



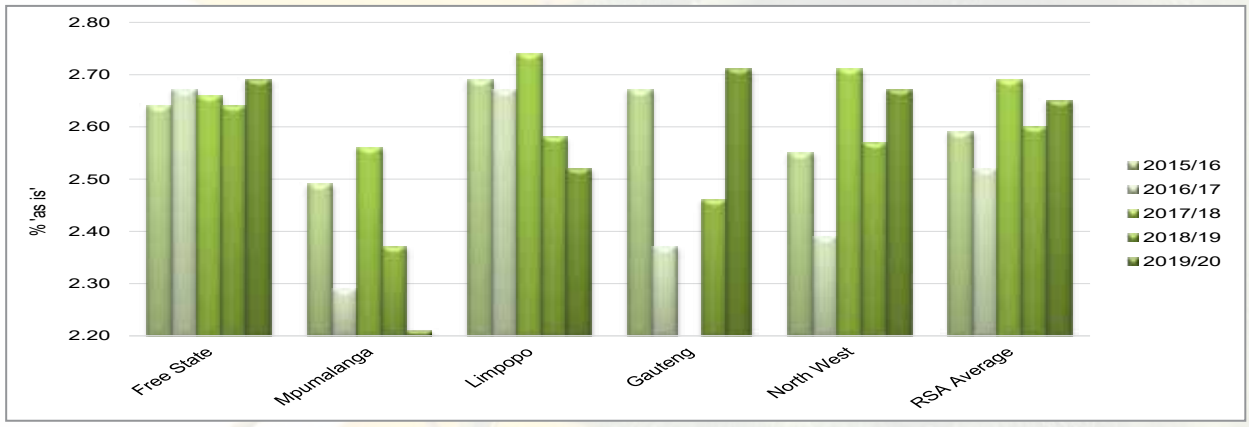
Graph 21: Average crude fat content per province over five seasons



Graph 22: Average crude fibre content per province over five seasons



Graph 23: Average ash content per province over five seasons



Please see a comparison of the moisture, crude protein and crude fat results between the crop survey and ARC Grain Crops sunflower cultivar trials' samples in Table 4.

Table 4: Comparison between the moisture, crude protein and crude fat results of the sunflower crop quality and ARC cultivar trial samples of the 2019/20 season

Analysis	Moisture, % (17hr, 103°C)	Crude Protein, % (as is)	Crude Fat, % (as is)
Sunflower Crop Quality Survey results			
Average	4.8	15.66	38.7
Minimum	2.9	11.54	30.2
Maximum	7.5	19.84	47.0
Standard deviation	0.73	1.40	2.54
No. of samples	***176***	***176***	***176***
ARC Grains Crops Cultivar trial sample results			
Average	5.3	15.84	40.4
Minimum	3.2	11.44	25.6
Maximum	7.6	22.95	53.8
Standard deviation	0.88	2.42	7.22
No. of samples	***104***	***104***	***104***
% Difference between crop and cultivar samples	***-0.5***	***-0.18***	***-1.7***

See Table 5 on page 23 for a summary of the RSA Sunflower Crop Quality averages of the 2019/20 season compared to those of the 2018/19 season.

Please also see pages 24 to 30 for the average sunflower quality per region.

Table 5: South African Sunflower Crop Quality Averages 2019/20 vs 2018/19						
Class and Grade Sunflower	**2019/20**			**2018/19**		
	FH1	**COSF**	**Average**	**FH1**	**COSF**	**Average**
Grading:						
1. Damaged sunflower seed, %	0.10	1.52	0.63	0.09	0.34	0.15
2. Screenings, %	1.68	3.69	2.42	1.61	4.04	2.21
3. Sclerotia, %	0.38	0.84	0.55	0.19	1.15	0.43
4. Foreign Matter, %	0.98	2.52	1.55	1.01	2.11	1.28
5. Deviations in 2,3 and 4 collectively, %: Provided that such deviations are individually within the limits of said items	3.04	7.05	4.52	2.82	7.30	3.92
Musty, sour, khaki bush or other undesired smell	No	No	No	No	No	No
Substance present that renders the seed unsuitable for human or animal consumption or for processing into or utilization thereof as food or feed	No	No	No	No	No	No
Poisonous seeds (*Crotalaria sp., Datura sp., Ricinis communis*)	0	3	1	0	2	1
Poisonous seeds (*Argemone mexicana L., Convolvulus sp., Ipomoea purpurea Roth., Lolium temulentum, Xanthium sp.*)	0	0	0	0	0	0
Number of samples	***111***	***65***	***176***	***133***	***43***	***176***
Nutritional analysis:						
Moisture, % (5 hr, 105 °C)	4.7	4.8	4.8	4.7	4.6	4.7
Crude Protein, % (as is)	15.74	15.51	15.66	16.59	15.80	16.40
Crude Fat, % (as is)	39.1	38.2	38.7	38.0	37.8	37.9
Crude Fibre, % (as is)	21.6	22.5	21.9	22.3	23.1	22.4
Ash, % (as is)	2.63	2.70	2.65	2.60	2.59	2.60
Number of samples	***111***	***65***	***176***	***133***	***43***	***176***

South Africa
REGIONAL SUNFLOWER QUALITY

PRODUCTION REGION	(12) North-West Western Region				(13) North-West Central Region (Sannieshof)				(14) North-West Southern Region			
Grading:	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***
1. Damaged sunflower seed, %	0.00	0.00	0.00	0.00	0.16	0.00	0.54	0.20	0.07	0.00	0.90	0.20
2. Screenings, %	1.67	0.91	2.46	0.56	3.90	2.50	5.80	1.12	1.76	0.20	5.92	1.34
3. Sclerotia, %	0.04	0.00	0.10	0.05	1.77	0.74	3.96	1.20	0.24	0.00	1.66	0.37
4. Foreign Matter, %	1.10	0.90	1.40	0.22	0.89	0.40	1.28	0.31	1.51	0.10	5.04	1.44
5. Deviations in 2, 3 and 4 collectively, %: Provided that such deviations are individually within the limits of said items	2.81	1.81	3.86	0.76	6.56	4.80	8.94	1.52	3.51	0.69	8.92	2.29
Poisonous seeds *(Crotalaria sp., Datura sp., Ricinis communis)*	2	0	10	4.47	1	0	6	2.12	1	0	20	4.22
Poisonous seeds *(Argemone mexicana L., Convolvulus sp., Ipomoea purpurea Roth., Lolium temulentum, Xanthium sp.)*	0	0	0	0.00	0	0	0	0.00	0	0	0	0.00
Number of samples	***5***				***8***				***23***			
Nutritional analysis:	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***
Moisture, % (5 hr, 105 °C)	4.8	4.1	5.5	0.52	4.0	3.0	5.9	0.96	4.8	3.4	6.1	0.70
Crude Protein, % (as is)	15.66	14.28	16.89	1.06	15.63	15.10	16.62	0.60	15.38	13.87	18.62	1.14
Crude Fat, % (as is)	37.1	35.2	39.7	1.63	40.4	36.7	42.5	1.87	39.6	31.2	43.8	2.91
Crude Fibre, % (as is)	23.7	23.0	24.9	0.75	21.1	19.4	23.1	1.22	21.4	18.8	24.5	1.74
Ash, % (as is)	2.67	2.39	3.15	0.29	2.73	2.59	2.82	0.09	2.54	2.31	3.19	0.18
Number of samples	***5***				***8***				***23***			

South Africa
REGIONAL SUNFLOWER QUALITY

PRODUCTION REGION	(15) North-West South-Eastern Region				(16) North-West Central-Eastern Region				(17) North-West Central-Northern Region (Ottosdal)			
Grading:	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***
1. Damaged sunflower seed, %	0.03	0.00	0.18	0.07	0.08	0.00	0.18	0.09	0.07	0.00	0.24	0.11
2. Screenings, %	1.32	1.18	1.46	0.10	1.62	0.30	4.11	1.31	2.03	0.92	3.90	1.03
3. Sclerotia, %	0.04	0.00	0.22	0.09	0.28	0.00	0.64	0.24	1.05	0.09	2.18	0.73
4. Foreign Matter, %	1.61	0.71	4.17	1.30	1.59	0.26	5.10	1.85	1.53	0.30	6.00	1.99
5. Deviations in 2, 3 and 4 collectively, %: Provided that such deviations are individually within the limits of said items	2.97	2.17	5.35	1.20	3.49	2.04	9.53	2.96	4.61	1.86	10.02	2.80
Poisonous seeds *(Crotalaria sp., Datura sp., Ricinis communis)*	0	0	0	0.00	0	0	0	0.00	1	0	5	1.89
Poisonous seeds *(Argemone mexicana L., Convolvulus sp., Ipomoea purpurea Roth., Lolium temulentum, Xanthium sp.)*	0	0	0	0.00	0	0	0	0.00	0	0	0	0.00
Number of samples	***6***				***6***				***7***			
Nutritional analysis:	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***
Moisture, % (5 hr, 105 °C)	4.9	4.4	5.5	0.47	4.8	4.0	6.3	0.87	5.1	3.5	6.3	0.97
Crude Protein, % (as is)	17.18	15.73	19.13	1.54	15.73	14.18	18.33	1.55	15.16	14.40	15.57	0.38
Crude Fat, % (as is)	38.6	37.7	39.2	0.71	39.4	30.2	42.6	4.68	38.2	32.4	42.5	3.00
Crude Fibre, % (as is)	21.4	20.5	23.1	0.93	21.2	18.1	25.0	2.41	22.5	19.3	23.9	1.55
Ash, % (as is)	2.91	2.68	3.12	0.19	2.74	2.56	2.91	0.14	2.72	2.56	3.03	0.16
Number of samples	***6***				***6***				***7***			

South Africa
REGIONAL SUNFLOWER QUALITY

PRODUCTION REGION	(18) North-West Central Region (Ventersdorp)				(19) North-West Central Region (Lichtenburg)				(20) North-West Eastern Region			
Grading:	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***
1. Damaged sunflower seed, %	0.14	0.00	0.38	0.14	0.13	0.00	0.54	0.22	0.32	0.00	1.60	0.72
2. Screenings, %	1.66	0.84	3.62	1.00	4.84	2.18	12.02	3.73	2.76	1.18	6.70	2.29
3. Sclerotia, %	0.91	0.08	1.98	0.71	0.68	0.08	2.32	0.83	0.40	0.00	0.96	0.43
4. Foreign Matter, %	1.16	0.12	3.20	1.11	2.06	0.40	5.20	1.78	1.44	0.80	1.90	0.55
5. Deviations in 2, 3 and 4 collectively, %: Provided that such deviations are individually within the limits of said items	3.73	1.90	6.24	1.67	7.58	3.82	17.44	5.60	4.60	2.84	8.60	2.32
Poisonous seeds *(Crotalaria sp., Datura sp., Ricinis communis)*	4	0	17	6.83	0	0	0	0.00	6	0	16	7.80
Poisonous seeds *(Argemone mexicana L., Convolvulus sp., Ipomoea purpurea Roth., Lolium temulentum, Xanthium sp.)*	0	0	0	0.00	0	0	0	0.00	0	0	0	0.00
Number of samples	***6***				***6***				***5***			
Nutritional analysis:	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***
Moisture, % (5 hr, 105 °C)	4.4	3.1	5.0	0.67	5.0	2.9	6.2	1.16	4.9	3.6	6.1	1.02
Crude Protein, % (as is)	14.96	14.09	16.55	0.92	15.09	12.92	16.13	1.13	16.12	15.37	17.71	0.99
Crude Fat, % (as is)	40.4	39.4	41.8	0.90	39.2	36.3	47.0	4.05	38.4	37.3	40.0	1.38
Crude Fibre, % (as is)	21.7	20.4	22.5	0.88	23.4	22.3	24.4	0.98	21.2	20.8	21.7	0.35
Ash, % (as is)	2.71	2.53	2.97	0.15	2.74	2.62	2.82	0.08	2.63	2.47	2.83	0.15
Number of samples	***6***				***6***				***5***			

South Africa
REGIONAL SUNFLOWER QUALITY

PRODUCTION REGION	(21) Free State North-Western Region (Viljoenskroon)				(22) Free State North-Western Region (Bothaville)				(23) Free State North-Western Region (Bultfontein)			
Grading:	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***
1. Damaged sunflower seed, %	0.61	0.00	12.60	2.56	0.18	0.00	0.60	0.24	0.17	0.00	1.85	0.47
2. Screenings, %	2.58	0.36	6.16	1.51	3.10	1.04	6.70	2.10	2.69	0.70	6.23	1.58
3. Sclerotia, %	0.39	0.00	1.62	0.47	0.27	0.00	0.60	0.25	0.30	0.00	1.06	0.33
4. Foreign Matter, %	1.83	0.42	7.70	1.87	3.37	0.72	9.84	3.36	2.17	0.33	6.87	1.84
5. Deviations in 2, 3 and 4 collectively, %: Provided that such deviations are individually within the limits of said items	4.80	1.04	10.80	2.54	6.74	3.68	13.94	4.38	5.17	1.79	10.74	2.85
Poisonous seeds *(Crotalaria sp., Datura sp., Ricinis communis)*	1	0	10	2.62	5	0	10	4.47	1	0	12	3.22
Poisonous seeds *(Argemone mexicana L., Convolvulus sp., Ipomoea purpurea Roth., Lolium temulentum, Xanthium sp.)*	0	0	10	2.04	0	0	0	0.00	0	0	0	0.00
Number of samples	***24***				***6***				***17***			
Nutritional analysis:	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***
Moisture, % (5 hr, 105 °C)	4.7	3.5	7.5	0.88	5.2	4.8	5.5	0.27	5.1	4.5	5.9	0.46
Crude Protein, % (as is)	15.85	13.05	18.10	1.24	16.02	15.61	16.43	0.34	16.83	14.61	19.55	1.31
Crude Fat, % (as is)	39.0	34.4	44.5	2.51	36.3	32.6	38.6	2.38	37.7	32.5	42.5	2.77
Crude Fibre, % (as is)	21.5	16.8	24.8	1.86	22.7	20.1	25.5	1.88	21.9	15.7	24.5	2.12
Ash, % (as is)	2.75	2.31	3.14	0.21	2.73	2.46	3.04	0.20	2.86	2.32	3.29	0.26
Number of samples	***24***				***6***				***17***			

South Africa
REGIONAL SUNFLOWER QUALITY

PRODUCTION REGION	(24) Free State Central Region				(25) Free State South-Western Region				(26) Free State South-Eastern Region			
Grading:	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***
1. Damaged sunflower seed, %	0.05	0.00	0.32	0.11	0.12	0.00	0.24	0.17	0.34	0.00	0.72	0.29
2. Screenings, %	3.16	0.32	15.36	4.00	1.22	1.00	1.44	0.31	2.84	0.54	6.83	2.21
3. Sclerotia, %	0.34	0.00	1.78	0.47	1.05	0.24	1.86	1.15	2.95	0.56	7.84	2.36
4. Foreign Matter, %	1.15	0.55	2.76	0.66	1.65	1.50	1.80	0.21	1.71	0.50	4.44	1.30
5. Deviations in 2, 3 and 4 collectively, %: Provided that such deviations are individually within the limits of said items	4.66	1.61	18.28	4.50	3.92	3.04	4.80	1.24	7.50	2.66	13.29	4.01
Poisonous seeds *(Crotalaria sp., Datura sp., Ricinis communis)*	3	0	40	11.55	4	0	8	5.66	0	0	0	0.00
Poisonous seeds *(Argemone mexicana L., Convolvulus sp., Ipomoea purpurea Roth., Lolium temulentum, Xanthium sp.)*	0	0	0	0.00	0	0	0	0.00	0	0	0	0.00
Number of samples	***12***				***2***				***9***			
Nutritional analysis:	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***
Moisture, % (5 hr, 105 °C)	5.0	4.0	5.8	0.72	4.8	4.6	5.0	0.28	4.6	4.1	5.0	0.33
Crude Protein, % (as is)	14.67	12.74	16.02	0.98	14.77	14.13	15.41	0.91	13.70	12.64	15.42	1.01
Crude Fat, % (as is)	37.6	36.2	41.1	1.47	37.3	36.9	37.6	0.49	38.4	36.1	40.7	1.67
Crude Fibre, % (as is)	23.4	21.7	25.2	1.11	23.8	23.7	23.9	0.14	23.2	21.7	24.7	0.84
Ash, % (as is)	2.52	2.40	2.69	0.10	2.87	2.79	2.94	0.11	2.61	2.45	2.85	0.14
Number of samples	***12***				***2***				***9***			

South Africa
REGIONAL SUNFLOWER QUALITY

PRODUCTION REGION	(27) Free State Northern Region				(28) Free State Eastern Region				(29) Mpumalanga Southern Region			
Grading:	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***
1. Damaged sunflower seed, %	0.52	0.00	3.10	1.27	0.03	0.00	0.18	0.06	12.77	3.66	16.60	4.69
2. Screenings, %	2.24	0.86	4.00	1.46	1.23	0.52	2.32	0.60	1.29	0.90	2.28	0.50
3. Sclerotia, %	0.08	0.00	0.34	0.14	0.76	0.00	3.50	1.19	0.04	0.00	0.24	0.10
4. Foreign Matter, %	1.92	0.50	4.12	1.43	1.09	0.30	3.14	0.88	0.70	0.18	1.36	0.39
5. Deviations in 2, 3 and 4 collectively, %: Provided that such deviations are individually within the limits of said items	4.23	1.36	8.12	2.43	3.08	1.42	6.52	2.00	2.03	1.08	3.88	0.97
Poisonous seeds *(Crotalaria sp., Datura sp., Ricinis communis)*	1	0	3	1.22	0	0	0	0.00	0	0	0	0.00
Poisonous seeds *(Argemone mexicana L., Convolvulus sp., Ipomoea purpurea Roth., Lolium temulentum, Xanthium sp.)*	0	0	0	0.00	0	0	0	0.00	0	0	0	0.00
Number of samples	***6***				***8***				***6***			
Nutritional analysis:	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***
Moisture, % (5 hr, 105 °C)	5.0	4.6	5.5	0.38	4.2	3.2	5.4	0.76	4.7	4.5	5.1	0.28
Crude Protein, % (as is)	15.86	13.95	18.57	1.58	15.61	14.50	17.70	0.95	14.79	14.48	15.30	0.32
Crude Fat, % (as is)	39.0	36.0	41.8	2.07	40.1	35.4	43.1	2.36	39.7	37.1	41.3	1.53
Crude Fibre, % (as is)	22.0	20.8	22.7	0.80	20.9	18.1	25.4	2.63	24.1	21.3	25.2	1.44
Ash, % (as is)	2.50	2.35	2.69	0.13	2.55	2.10	2.83	0.21	2.21	2.14	2.36	0.08
Number of samples	***6***				***8***				***6***			

South Africa
REGIONAL SUNFLOWER QUALITY

PRODUCTION REGION	(34) Gauteng Region				(35) Limpopo Region			
Grading:	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***
1. Damaged sunflower seed, %	0.28	-	-	-	0.04	0.00	0.40	0.11
2. Screenings, %	4.79	-	-	-	2.55	0.36	6.74	1.86
3. Sclerotia, %	0.22	-	-	-	0.00	0.00	0.00	0.00
4. Foreign Matter, %	1.65	-	-	-	0.72	0.10	1.82	0.52
5. Deviations in 2, 3 and 4 collectively, %: Provided that such deviations are individually within the limits of said items	6.66	-	-	-	3.27	0.50	6.98	1.88
Poisonous seeds *(Crotalaria sp., Datura sp., Ricinis communis)*	0	-	-	-	0	0	0	0.00
Poisonous seeds *(Argemone mexicana L., Convolvulus sp., Ipomoea purpurea Roth., Lolium temulentum, Xanthium sp.)*	0	-	-	-	0	0	0	0.00
Number of samples	***1***				***13***			
Nutritional analysis:	***ave***	***min***	***max***	***stdev***	***ave***	***min***	***max***	***stdev***
Moisture, % (5 hr, 105 °C)	4.2	-	-	-	4.6	3.4	5.2	0.49
Crude Protein, % (as is)	11.54	-	-	-	17.08	15.01	19.84	1.34
Crude Fat, % (as is)	35.6	-	-	-	38.4	35.1	41.5	1.98
Crude Fibre, % (as is)	25.4	-	-	-	20.1	17.2	22.5	1.46
Ash, % (as is)	2.71	-	-	-	2.52	2.08	2.72	0.17
Number of samples	***1***				***13***			

Fatty acid Profile

Fatty acid profiles are the most important tool for identification of authenticity of vegetable fats and oils. All types of oil have their own specific fatty acid profile which is unique to that product. Fatty acids are typically esterified to a glycerol backbone to form triglycerides (also called fats or oils). Fatty acids are either described as saturated or unsaturated, with saturated fatty acids being solid at room temperature and unsaturated fatty acids being liquid at room temperature. Unsaturated fatty acids are further subdivided into mono-unsaturated (one double bond in the carbon chain) or poly-unsaturated (more than one double bond in the carbon chain). The unique fatty acid profile of each product/crop is a combination of saturated, mono-unsaturated and poly-unsaturated oils and is specific to that type of oil.

Fatty acid profiles of every crop, however, are subject to variation. The variation or typical pattern of fatty acids in a specific oil not only influences the stability and physical properties of the oil but also aids in distinguishing one type of oil from another. Variation of fatty acids within the same product depend on climate, latitude, soil type, cultivar, rainfall as well as seasonal variation. These variations should be included when ranges for identification of authenticity are determined.

It is imperative to include ranges wherein fatty acids vary, in order to successfully validate the authenticity of a specific vegetable oil. Building of a database requires gathering of information over different seasons, areas and cultivars in order to give a true reflection of the ranges wherein fatty acids can differ. Currently, no national updated database for fatty acid composition of sunflower oil is available.

It is important that South Africa, as a sunflower seed producing country, develop and maintain a national fatty acid profile database to the benefit of the Oil Seed Industry. Annual analysis of crop and cultivar samples will ensure that the natural variation caused by different cultivars as well as the influence of climate and locality are included in the database values. Seasonal variations will also be addressed. Recording all variation applicable to the crops in the database will enable the annual review of the specified ranges.

Precision Oil Laboratories was subcontracted for the second consecutive year to perform fatty acid profile analyses on 20 composite crop samples representing different production regions as well as 20 cultivar samples from different localities. Please refer to Tables 6, 7 and 8 on pages 32 to 34 for the results.

The following fatty acid were included in the profile analysis:

C14:0	Myristic acid	C18:3n5	n5 Linolenic acid
C16:0	Palmitic acid	C18:3n3	n3 Linolenic acid
C16:1	Palmitoleic acid	C20:0	Arachidic acid
C17:0	Margaric acid	C20:1	Eicosenoic acid
C17:1	Glinkgolic acid	C20:2	Eicosadienoic acid
C18:0	Stearic acid	C21:0	Heneicosanoic acid
C18:1 c	cis Oleic acid	C22:0	Behenic acid
C18:2 c	cis Linoleic acid	C24:0	Lignoceric acid
C18:3n6	n6 Linolenic acid	C24:1	Nervonic acid

References:

Accum, F., 1820. “A Treatise on Adulteration of Food and Culinary Poisons”, Longman, Hurst, Rees, Orme and Row, London.

Gunstone, F.D., 1996. Fatty Acid and Lipid Chemistry, 1st edition, Blackie Academic & Professional, London, pp 1-23.

Rossell, J.B., Measurement of rancidity. IN: J.C. and Hamilton R.J. (Eds), Rancidity in Foods. Blackie Academic and Professional, Glasgow, pp22-53.

Van Niekerk, P.J., 1990. Determination of the component oils of edible oil blends. University of Pretoria.

The Fatty acid Profile information was supplied by Dr. Mathilda Mostert from Precision Oil Laboratories.

Table 6: Fatty acid profile results of a selection of crop quality samples from the 2019/20 season

Province	Region	g Fatty acids/100 g Fatty Acids																	
		C14:0	C16:0	C16:1	C17:0	C17:1	C18:0	C18:1 c	C18:2 c	C18:3n6	C18:3n5	C18:3n3	C20:0	C20:1	C20.2	C21:0	C22:0	C24:0	C24:1
North West	12	ND	6.46	ND	ND	ND	6.01	17.57	67.7	ND	0.32	<LOQ	0.56	<LOQ	ND	ND	0.95	<LOQ	ND
	13	ND	5.19	ND	ND	ND	5.35	21.29	66.1	ND	0.30	<LOQ	0.49	<LOQ	ND	ND	0.83	<LOQ	ND
	14	ND	6.09	ND	ND	ND	5.81	17.69	68.3	ND	<LOQ	<LOQ	0.51	<LOQ	ND	ND	0.89	<LOQ	ND
	15	ND	5.44	ND	ND	ND	7.73	16.54	68.2	ND	0.30	<LOQ	0.56	<LOQ	ND	ND	0.79	<LOQ	ND
	16	ND	5.57	ND	ND	ND	5.85	19.61	66.9	ND	0.41	<LOQ	0.47	<LOQ	ND	ND	0.77	<LOQ	ND
	17	ND	5.47	ND	ND	ND	6.01	19.62	67.1	ND	ND	<LOQ	0.53	<LOQ	ND	ND	0.78	<LOQ	ND
	18	ND	6.29	ND	ND	ND	4.96	17.98	68.9	ND	<LOQ	<LOQ	0.48	<LOQ	ND	ND	0.83	<LOQ	ND
	19	ND	6.18	ND	ND	ND	7.58	15.60	68.8	ND	ND	<LOQ	0.59	<LOQ	ND	ND	0.88	<LOQ	ND
	Min	-	*5.19*	-	-	-	*4.96*	*15.60*	*66.1*	-	*0.30*	-	*0.47*	-	-	-	*0.77*	-	-
	Max	-	*6.46*	-	-	-	*7.73*	*21.29*	*68.9*	-	*0.41*	-	*0.59*	-	-	-	*0.95*	-	-
	N	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*
Free State	20	ND	6.20	ND	ND	ND	6.16	16.43	69.2	ND	ND	<LOQ	0.54	<LOQ	ND	ND	0.96	<LOQ	ND
	21	ND	6.20	ND	ND	ND	5.05	16.58	70.0	ND	0.34	<LOQ	0.48	<LOQ	ND	ND	0.89	<LOQ	ND
	21	ND	5.93	ND	ND	ND	5.78	22.52	63.6	ND	0.35	<LOQ	0.51	<LOQ	ND	ND	0.89	<LOQ	ND
	22	ND	6.04	ND	ND	ND	4.97	19.53	67.5	ND	<LOQ	<LOQ	0.48	<LOQ	ND	ND	0.92	<LOQ	ND
	23	ND	5.38	ND	ND	ND	6.84	17.47	68.2	ND	0.33	<LOQ	0.53	<LOQ	ND	ND	0.85	<LOQ	ND
	24	ND	5.57	ND	ND	ND	5.76	16.83	69.8	ND	ND	<LOQ	0.54	<LOQ	ND	ND	1.00	<LOQ	ND
	26	ND	5.87	ND	ND	ND	6.68	16.39	69.0	ND	ND	<LOQ	0.54	<LOQ	ND	ND	0.99	<LOQ	ND
	27	ND	6.06	ND	ND	ND	5.61	19.53	66.6	ND	<LOQ	<LOQ	0.56	<LOQ	ND	ND	0.88	<LOQ	ND
	28	ND	5.26	ND	ND	ND	6.30	16.41	69.8	ND	0.37	<LOQ	0.52	<LOQ	ND	ND	0.81	<LOQ	ND
	Min	-	*5.26*	-	-	-	*4.97*	*16.39*	*63.6*	-	*0.33*	-	*0.48*	-	-	-	*0.81*	-	-
	Max	-	*6.20*	-	-	-	*6.84*	*22.52*	*70.0*	-	*0.37*	-	*0.56*	-	-	-	*1.00*	-	-
	N	*9*	*9*	*9*	*9*	*9*	*9*	*9*	*9*	*9*	*9*	*9*	*9*	*9*	*9*	*9*	*9*	*9*	*9*
Mpumalanga	29	ND	6.33	ND	ND	ND	5.22	18.44	67.8	ND	0.30	<LOQ	0.50	<LOQ	ND	ND	0.89	<LOQ	ND
Gauteng	34	ND	7.16	ND	ND	ND	4.25	16.99	69.7	ND	ND	<LOQ	0.48	<LOQ	ND	ND	0.86	<LOQ	ND
Limpopo	35	ND	6.27	ND	ND	ND	7.24	15.87	68.5	ND	<LOQ	<LOQ	0.57	<LOQ	ND	ND	0.89	<LOQ	ND
RSA	*Min*	-	*5.19*	-	-	-	*4.25*	*15.60*	*63.60*	-	*0.30*	-	*0.47*	-	-	-	*0.77*	-	-
	Max	-	*7.16*	-	-	-	*7.73*	*22.52*	*69.97*	-	*0.41*	-	*0.59*	-	-	-	*1.00*	-	-
	N	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*

Note:
Limit of detection (LOD) = 0.09 g Fatty acid/100 g Fatty acids.
Limit of quantitation (LOQ) = 0.28 g Fatty acid/100 g Fatty acids.
Values below the limit of quantitation cannot be accurately quantified.
ND = Not detected

Table 7: Fatty acid profile results of a selection of cultivar samples from the 2019/20 season

Province	Locality	Region	Cultivar	g Fatty acids/100 g Fatty Acids																
				C14:0	C16:0	C16:1	C17:0	C17:1	C18:0	C18:1 c	C18:2 c	C18:3n6	C18:3n5	C18:3n3	C20:0	C20:1	C20.2	C21:0	C22:0	C24:0	C24:1
North West	Potchefstroom 1	18	AGSUN 5106 CLP	ND	5.38	ND	ND	ND	4.44	28.36	59.8	ND	<LOQ	ND	0.41	<LOQ	ND	ND	0.81	<LOQ	ND
			AGSUN 8251	ND	4.80	ND	ND	ND	5.25	33.5	54.6	ND	ND	ND	0.45	<LOQ	ND	ND	0.90	<LOQ	ND
			P 65 LL14	ND	5.96	ND	ND	ND	3.94	22.15	66.0	ND	0.26	ND	0.42	<LOQ	ND	ND	0.78	<LOQ	ND
			PAN 7170	ND	5.71	ND	ND	ND	3.57	23.50	65.5	ND	<LOQ	ND	0.38	<LOQ	ND	ND	0.78	<LOQ	ND
			SY 3975 CLOH	0.00	3.13	ND	ND	ND	3.61	86.4	4.43	ND	ND	<LOQ	0.36	<LOQ	ND	ND	1.32	0.38	ND
		Min		-	*3.13*	-	-	-	*3.57*	*22.15*	*4.43*	-	-	-	*0.36*	-	-	-	*0.78*	-	-
		Max		-	*5.96*	-	-	-	*5.25*	*86.4*	*66.0*	-	*0.26*	-	*0.45*	-	-	-	*1.32*	*0.38*	-
		N		*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*
	Potchefstroom 3	18	AGSUN 5106 CLP	ND	5.16	ND	ND	ND	6.05	21.16	65.7	ND	<LOQ	ND	0.49	<LOQ	ND	ND	0.93	<LOQ	ND
			AGSUN 8251	ND	5.25	ND	ND	ND	6.37	22.36	64.0	ND	<LOQ	ND	0.53	<LOQ	ND	ND	0.88	<LOQ	ND
			P 65 LL14	ND	5.66	ND	ND	ND	5.08	18.08	69.1	ND	<LOQ	<LOQ	0.49	<LOQ	ND	ND	0.85	<LOQ	ND
			PAN 7170	ND	5.11	ND	ND	ND	4.71	20.67	67.5	ND	0.20	<LOQ	0.45	<LOQ	ND	ND	0.88	<LOQ	ND
			SY 3975 CLOH	ND	3.03	ND	ND	ND	5.02	82.4	6.75	ND	ND	<LOQ	0.47	<LOQ	ND	ND	1.60	0.39	ND
		Min		-	*3.03*	-	-	-	*4.71*	*18.08*	*6.75*	-	-	-	*0.45*	-	-	-	*0.85*	-	-
		Max		-	*5.66*	-	-	-	*6.37*	*82.4*	*69.1*	-	*0.20*	-	*0.53*	-	-	-	*1.60*	*0.39*	-
		N		*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*
	Potchefstroom 5	18	AGSUN 5106 CLP	ND	6.39	ND	ND	ND	8.12	14.39	68.6	ND	ND	<LOQ	0.77	<LOQ	ND	ND	1.02	<LOQ	ND
			AGSUN 8251	ND	6.38	ND	ND	ND	8.42	11.81	71.1	ND	0.03	<LOQ	0.78	<LOQ	ND	ND	0.92	<LOQ	ND
			P 65 LL14	ND	6.26	ND	ND	ND	8.42	14.13	68.9	ND	ND	<LOQ	0.77	ND	ND	ND	1.13	0.29	ND
			PAN 7170	ND	6.33	ND	ND	ND	7.74	14.72	68.9	ND	ND	<LOQ	0.70	<LOQ	ND	ND	1.08	<LOQ	ND
			SY 3975 CLOH	ND	4.02	ND	ND	ND	7.57	71.2	13.98	ND	0.00	<LOQ	0.70	<LOQ	ND	ND	1.81	0.38	ND
		Min		-	*4.02*	-	-	-	*7.57*	*11.81*	*13.98*	-	-	-	*0.70*	-	-	-	*0.92*	*0.29*	-
		Max		-	*6.39*	-	-	-	*8.42*	*71.2*	*71.1*	-	*0.03*	-	*0.78*	-	-	-	*1.81*	*0.38*	-
		N		*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*
	Min			-	*3.03*	-	-	-	*3.57*	*11.81*	*4.43*	-	*0.03*	-	*0.36*	-	-	-	*0.78*	*0.29*	-
	Max			-	*6.39*	-	-	-	*8.42*	*86.4*	*71.1*	-	*0.26*	-	*0.78*	-	-	-	*1.81*	*0.39*	-
	N			*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*
Free State	Kroonstad	24	AGSUN 5106 CLP	ND	5.81	ND	ND	ND	9.15	11.68	71.0	ND	ND	<LOQ	0.76	<LOQ	ND	ND	1.05	<LOQ	ND
			AGSUN 8251	ND	6.17	ND	ND	ND	8.62	9.53	73.5	ND	ND	<LOQ	0.73	<LOQ	ND	ND	0.91	<LOQ	ND
			P 65 LL14	ND	5.79	ND	ND	ND	8.00	11.8	72.2	ND	ND	<LOQ	0.68	<LOQ	ND	ND	0.98	<LOQ	ND
			PAN 7170	ND	6.01	ND	ND	ND	6.52	12.68	72.7	ND	ND	<LOQ	0.58	<LOQ	ND	ND	0.94	<LOQ	ND
			SY 3975 CLOH	ND	3.29	ND	ND	ND	6.99	76.3	10.42	ND	ND	<LOQ	0.63	<LOQ	ND	ND	1.69	0.35	ND
		Min		-	*3.29*	-	-	-	*6.52*	*9.53*	*10.42*	-	-	-	*0.58*	-	-	-	*0.91*	-	-
		Max		-	*6.17*	-	-	-	*9.15*	*76.3*	*73.5*	-	-	-	*0.76*	-	-	-	*1.69*	*0.35*	-
		N		*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*
RSA	*Min*			-	*3.03*	-	-	-	*3.57*	*9.53*	*4.43*	-	*0.03*	-	*0.36*	-	-	-	*0.78*	*0.29*	-
	Max			-	*6.39*	-	-	-	*9.15*	*86.4*	*73.5*	-	*0.26*	-	*0.78*	-	-	-	*1.81*	*0.39*	-
	N			*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*

Note:
Limit of detection (LOD) = 0.09 g Fatty acid/100 g Fatty acids.
Limit of quantitation (LOQ) = 0.28 g Fatty acid/100 g Fatty acids.
Values below the limit of quantitation cannot be accurately quantified.
ND = Not detected

Table 8: Fatty acid profile results per cultivar from the 2019/20 season

Cultivar	Province	Region	g Fatty acids/100 g Fatty Acids																
			C14:0	C16:0	C16:1	C17:0	C17:1	C18:0	C18:1 c	C18:2 c	C18:3n6	C18:3n5	C18:3n3	C20:0	C20:1	C20.2	C21:0	C22:0	C24:0	C24:1
AGSUN 5106 CLP	North West	18	ND	5.38	ND	ND	ND	4.44	28.36	59.8	ND	<LOQ	ND	0.41	<LOQ	ND	ND	0.81	<LOQ	ND
			ND	5.16	ND	ND	ND	6.05	21.16	65.7	ND	<LOQ	ND	0.49	<LOQ	ND	ND	0.93	<LOQ	ND
			ND	6.39	ND	ND	ND	8.12	14.39	68.6	ND	ND	<LOQ	0.77	<LOQ	ND	ND	1.02	<LOQ	ND
	Free State	24	ND	5.81	ND	ND	ND	9.15	11.68	71.0	ND	ND	<LOQ	0.76	<LOQ	ND	ND	1.05	<LOQ	ND
Min			-	*5.16*	-	-	-	*4.44*	*11.68*	*59.8*	-	-	-	*0.41*	-	-	-	*0.81*	-	-
Max			-	*6.39*	-	-	-	*9.15*	*28.36*	*71.0*	-	-	-	*0.77*	-	-	-	*1.05*	-	-
N			*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*
AGSUN 8251	North West	18	ND	4.80	ND	ND	ND	5.25	33.5	54.6	ND	ND	ND	0.45	<LOQ	ND	ND	0.90	<LOQ	ND
			ND	5.25	ND	ND	ND	6.37	22.36	64.0	ND	<LOQ	ND	0.53	<LOQ	ND	ND	0.88	<LOQ	ND
			ND	6.38	ND	ND	ND	8.42	11.81	71.1	ND	0.03	<LOQ	0.78	<LOQ	ND	ND	0.92	<LOQ	ND
	Free State	24	ND	6.17	ND	ND	ND	8.62	9.53	73.5	ND	ND	<LOQ	0.73	<LOQ	ND	ND	0.91	<LOQ	ND
Min			-	*4.80*	-	-	-	*5.25*	*9.53*	*54.6*	-	-	-	*0.45*	-	-	-	*0.88*	-	-
Max			-	*6.38*	-	-	-	*8.62*	*33.5*	*73.5*	-	*0.03*	-	*0.78*	-	-	-	*0.92*	-	-
N			*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*
P 65 LL14	North West	18	ND	5.96	ND	ND	ND	3.94	22.15	66.0	ND	0.26	ND	0.42	<LOQ	ND	ND	0.78	<LOQ	ND
			ND	5.66	ND	ND	ND	5.08	18.08	69.1	ND	<LOQ	<LOQ	0.49	<LOQ	ND	ND	0.85	<LOQ	ND
			ND	6.26	ND	ND	ND	8.42	14.13	68.9	ND	ND	<LOQ	0.77	ND	ND	ND	1.13	0.29	ND
	Free State	24	ND	5.79	ND	ND	ND	8.00	11.81	72.2	ND	ND	<LOQ	0.68	<LOQ	ND	ND	0.98	<LOQ	ND
Min			-	*5.66*	-	-	-	*3.94*	*11.81*	*66.0*	-	-	-	*0.42*	-	-	-	*0.78*	-	-
Max			-	*6.26*	-	-	-	*8.42*	*22.15*	*72.2*	-	*0.26*	-	*0.77*	-	-	-	*1.13*	*0.29*	-
N			*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*
PAN 7170	North West	18	ND	5.71	ND	ND	ND	3.57	23.50	65.5	ND	<LOQ	ND	0.38	<LOQ	ND	ND	0.78	<LOQ	ND
			ND	5.11	ND	ND	ND	4.71	20.67	67.5	ND	0.20	<LOQ	0.45	<LOQ	ND	ND	0.88	<LOQ	ND
			ND	6.33	ND	ND	ND	7.74	14.72	68.9	ND	ND	<LOQ	0.70	<LOQ	ND	ND	1.08	<LOQ	ND
	Free State	24	ND	6.01	ND	ND	ND	6.52	12.68	72.7	ND	ND	<LOQ	0.58	<LOQ	ND	ND	0.94	<LOQ	ND
Min			-	*5.11*	-	-	-	*3.57*	*12.68*	*65.5*	-	-	-	*0.38*	-	-	-	*0.78*	-	-
Max			-	*6.33*	-	-	-	*7.74*	*23.50*	*72.7*	-	*0.20*	-	*0.70*	-	-	-	*1.08*	-	-
N			*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*
SY 3975 CLOH	North West	18	0.00	3.13	ND	ND	ND	3.61	86.4	4.43	ND	ND	<LOQ	0.36	<LOQ	ND	ND	1.32	0.38	ND
			ND	3.03	ND	ND	ND	5.02	82.4	6.75	ND	ND	<LOQ	0.47	<LOQ	ND	ND	1.60	0.39	ND
			ND	4.02	ND	ND	ND	7.57	71.2	13.98	ND	0.00	<LOQ	0.70	<LOQ	ND	ND	1.81	0.38	ND
	Free State	24	ND	3.29	ND	ND	ND	6.99	76.3	10.42	ND	ND	<LOQ	0.63	<LOQ	ND	ND	1.69	0.35	ND
Min			-	*3.03*	-	-	-	*3.61*	*71.2*	*4.43*	-	-	-	*0.36*	-	-	-	*1.32*	*0.35*	-
Max			-	*4.02*	-	-	-	*7.57*	*86.4*	*13.98*	-	-	-	*0.70*	-	-	-	*1.81*	*0.39*	-
N			*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*
RSA	*Min*		-	*3.03*	-	-	-	*3.57*	*9.53*	*4.43*	-	-	-	*0.36*	-	-	-	*0.78*	*0.35*	-
	Max		-	*6.39*	-	-	-	*9.15*	*86.4*	*73.5*	-	*0.26*	-	*0.78*	-	-	-	*1.81*	*0.39*	-
	N		*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*

Note:
Limit of detection (LOD) = 0.09 g Fatty acid/100 g Fatty acids.
Limit of quantitation (LOQ) = 0.28 g Fatty acid/100 g Fatty acids.
Values below the limit of quantitation cannot be accurately quantified.
ND = Not detected

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 Sunflower Seed intended for sale in the Republic of South Africa (Government Notice NO. 45 of 22 January 2016).

See pages 67 to 74 of this report.

TEST WEIGHT:

Test weight provides a measure of the bulk density of grain and oilseeds.

Test weight does not form part of the grading regulations for sunflower seed in South Africa. An approximation of the test weight of South African sunflower seed is provided in this report for information purposes. The standard working procedure of the Kern 222 instrument, as described in ISO 7971-3:2019, was followed. The g/1 L filling mass of the sunflower seed samples was determined and divided by two. The test weight was then extrapolated by means of the following formulas obtained from the Test Weight Conversion Chart for Sunflower Seed, Oil of the Canadian Grain Commission: $y = 0.1936x + 2.2775$ (138 to 182 g/0.5 L) and $y = 0.1943x + 2.1665$ (183 to 227 g/0.5 L).

NUTRITIONAL ANALYSIS:

Milling

Prior to the chemical analyses, the sunflower seed samples were milled on a Retch ZM 200 mill fitted with a 1.0 mm screen.

Moisture

The moisture content of the samples was determined as a loss in weight when dried in an oven at 105 °C for 5 hours according to AgriLASA method 2.1, latest edition.

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.

Crude Fat

In-House method 024 was used for the determination of the crude fat 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.

Crude Fibre

In-House method 020 was used for the determination of the crude fibre in the samples. Crude fibre is the loss on ignition of the dried residue remaining after digestion of the sample with 1.25% Sulphuric acid (H_2SO_4) and 1.25% Sodium hydroxide (NaOH) solutions under specific conditions.

Ash

Ash is defined as the quantity of mineral matter which remains as incombustible residue of the tested substance, after application of the described working method. In-house method No. 011, based on AACCI method 08-03.01, was used for the determination. The samples were incinerated at 600 ± 15 °C in a muffle furnace for 2 hours.

PRECISION OIL LABORATORIES' FATTY ACID PROFILE METHODS:

Fat Extraction

In-House method POL 019 was used for the extraction of the crude fat from the samples. After sample preparation the fat is extracted by petroleum ether under reflux, followed by the removal of the solvent by evaporation. The residue obtained from the fat extraction is used for preparation of methyl esters for determination of the fatty acid profile

Fatty Acid Profile

In-House method POL 015 was used for determination of the fatty acid composition. Extracted fat is converted to methyl esters using an alkali catalyzed method. Methyl esters are injected into a Gas Chromatograph and an external fatty acid methyl ester standard is used to identify peaks based on retention times. The fatty acid composition is expressed as a total fatty acid content of 100% with different fatty acids representing a percentage of the total fatty acids.

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 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:

Southern 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)
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)
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: hannalien.meyer@sagl.co.za

Nominated Representative:

Mrs H Meyer

Issue No.: 29
Date of Issue: 14 October 2019
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)

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

Report

Evaluation of sunflower cultivars: 2019/2020 season

ARC-Grain Crops Institute in collaboration with the following seed companies: Agricol, Pannar, Pioneer, Syngenta, Sensako and Link Seed

Table of Contents

List of Tables

List of Figures

INTRODUCTION

Optimisation of crop production requires, among a number of inputs, the selection of a well performing cultivar. Sunflower cultivar trials, which are done since the nineteen seventies in South Africa, have the aim to enable farmers to optimise sunflower production through sound cultivar selection.

In this project, commercially available cultivars are evaluated in order to predict their future yield performances and to assess their seed composition. This project is the only unbiased effort in South Africa that strives to evaluate important cultivars in the main areas of production. The information generated in these field trials on grain yield and seed quality is not only available to farmers but to all interested parties.

MATERIALS AND METHODS

This project was conducted during the 2019/2020 season with the voluntary collaboration of Agricol, Pannar, Pioneer, Syngenta, Sensako and Link Seed. Seed companies entered 26 cultivars for evaluation (Table 1) and supplied seed to the ARC-GC which planned the field trials with randomised complete-block design layouts with three replicates. Germination tests, according to ISTA rules, were done on the supplied seed by a service provider (Senwes Grainlink). Seed germination from all cultivars exceeded the 80% requirement (Table 1). Seed from cultivars were packed according to trial plans and send to co-operators before the onset of the growing season.

Eleven of the 26 cultivars were Clearfield types on which the use of the post emergence broad leaf weed controlling herbicide mixture, imazapyr + imazamox (Euro-Lightning®), is possible. In the field trials these cultivars were treated in the same way as the regular cultivars and received no Euro-Lightning®. Two hybrids (LG 5626 HO & SY 3975 CL HO) of the 26 was high oleic acid.

Each collaborating seed company had to conduct at least one trial for each cultivar entry. Agricol was supplied with seed for 13 trials, Pannar with 5, Pioneer with 5 and Syngenta with 3, Link Seed with 3 and Sensako with 2. Five trials were planted by the ARC-GC with different planting dates. Trial sites were selected by collaborators and the co-workers involved are listed in Table 2.

two trials of Pannar not planted or not harvested due to bad trial quality, two trials of Pioneer were not planted or planted and not harvested, three trial of Syngenta not planted or damaged due to the hail and drought, two trials of Link Seed not planted or not correctly done, three trials were not successful due to late planting and sclerotinia, bird damage, replanting not harvested or even not planted. Four trials were not statistically successful and were not included in the results. Planting dates, amount of fertiliser applied, soil analyses and other agronomic details from some successful field trials are reported in Table 3. Grain yields were recorded on these trials while the period from planting to 50% flowering was recorded on four trials at Potchefstroom and three trials at Boskop with different planting dates and one trial at Fochville, Leeudorngstad, Sannieshof, Makwassie, Wolmaransstad and Ventersdorp

Yield data and seed samples were send by collaborators to ARC-GC for analyses. Seed from selected trials sent to SAGL for oil and protein content analyses. Yield data from 21 field trials were subjected to analyses of variance. The regression line technique as described by Loubser and Grimbeek (1984) was used to calculate yield probabilities for cultivars at different yield potentials from the 21 trials.

Yield probabilities were also calculated for 22 cultivars that were evaluated in 35 trials during 2018/2019 and 2019/2020.

RESULTS

Days from planting to flowering

The mean number of days from planting to 50% flowering of cultivars (Table 4) ranged from 66 RN 28485 to 71 days (AGSUN 5102 CLP, AGSUN 5103 CLP, AGSUN 5106 CLP, SY 3975 CLHO & PAN 7080). Calculated across cultivars and planting dates, the period from planting to flowering was 69 days. The longest days to flowering recorded at Potchefstroom planted on the 5th of February 2020.

Oil and protein concentration

The moisture free oil and protein concentrations of seed from seven trial localities, as analysed by the Southern African Grain Laboratory NPC, are shown in Tables 5 and 6 respectively. The oil analyses were done with a Soxhlet apparatus while the protein

analyses were done according to the Dumas method.
The moisture free oil content for cultivars at the various localities varied from 37.62 to 50.61% with an overall mean of 42.12%.
The highest mean oil concentration among localities was at Potchefstroom (planting date 18 December 2019) with 45.90%. The locality with the lowest mean oil content of 36.82% was Potchefstroom planting date was February 05, 2019. The highest oil concentration among cultivars and calculated across localities, was SY 3970 CL at 50.61% followed by RN 28584 at 48.36%

The average protein content varied from 15.95 to 19.56% among cultivars at the different localities. Among localities, Ventersdorp planted in January 15, 2020 had the highest and Potchefstroom planted in November 04 2019 the lowest protein content of 20.82 and 12.81% respectively. Calculated across localities, RN 28485 had the highest protein content (19.56 %) followed by AGSUN 5102 CLP and AGSUN 5101 CLP (19.5) while PAN 64 LL 23 the lowest (15.95%).

Seed yield

The mean seed yield of cultivars at the respective localities is presented in Table 7. The highest locality mean yield of 3.52 t ha^{-1} was obtained at Kroonstad planted on 17 of January 2020 and the lowest of 0.89 t ha^{-1}, at Potchefstroom planted on 5^{h} February 2020.

The five best performing cultivars, in terms of average yield calculated over localities, were PAN 7156 CLP, P 64 L L23, PAN 7080, AGSUN 5270 & PAN 7160 CLP. The overall mean yield for 2019/20 was 2.50 t ha^{-1}, 12 % higher than the mean yield of 2018/19.

Two high oleic cultivar (LG 5625 HO & SY 3975 CLOH) was entered for evaluation in 2019/2020. Eleven Clearfield and Clearfield Plus cultivars, AGSUN 5101 CLP, AGSUN 5102 CLP, AGSUN 5103 CLP, AGSUN 5106 CLP, P 65 LP 54, PAN 7102 CLP, PAN 7156 CLP, PAN 7160 CLP, SY 3975 CLOH and SY 3970 CL were entered. eight of these cultivars namely PAN 7156 CLP, PAN 7160 CLP, AGSUN 5103 CLP, AGSUN 5106 CLP, AGSUN 5102 CLP, PAN 7102 CLP, P 65 LP 54 and AGSUN 5101 CLP have yields higher than the overall mean yield of all cultivars.

Oil yield

Oil yield per unit area is the product of grain yield and seed oil content and presented in Table 8.

The oil yield for cultivars at the eleven localities varied from 0.91 to 1.18 t ha^{-1} with an overall mean of 1.03 t ha^{-1}. The locality with the highest mean oil yield was Potchefstroom planted in December 18, 2019 at 1.38 t ha^{-1}. P 64 LL 23 has the highest oil yield of 1.18 t ha^{-1} followed by SY 3970 CL with 1.17 t ha^{-1}

Parameters calculated from the analysis of variance

The trial mean yield, standard error of the trial mean and other parameters, calculated for each locality, are shown in Table 9. These parameters are presented for the evaluation of individual trials.

Regression line coordinates at different yield targets

Regression line coordinates at different yield targets, the overall mean yield, the intercept and slope from the regression line and yield stability (R^2- parameter) are shown in Table 10. The coordinate values of a particular cultivar are estimates of the mean expected yield at corresponding yield potentials. These values take the cultivar X environment interaction into account but not the yield stability. These values are accordingly not reliable for cultivar selection. Individual cultivar regression lines for 2019/20 are shown in Figure 1 and for the 22 cultivars evaluated in 2018/19 and 2019/20 in Figure 2.

The yield stability of cultivars varied up to 21 fold among cultivars (Table 10). Cultivars which had exceptionally high stabilities (R-parameter =1) were, PAN 7160 CLP, PAN 7080, PAN 7156 CLP, AGSUN 8251, AGSUN 5101 CLP, PAN 7100 and PAN 7170

Yield probability

The yield probability of a cultivar, is the probability of exceeding the mean yield of all cultivars, at a particular yield potential. The yield probabilities of all 26 cultivars for 2019/20 are shown in Table 11. It takes account of both the cultivar X environment interaction and the yield stability and is therefore a reliable measure for cultivar choice. Yield probabilities higher than or equal to 60% in Table 11 indicates which cultivars would be sensible choices at the various yield potentials

The yield probabilities of 22 cultivars evaluated in 35 trials in 2018/19 and 2019/20, and yield probabilities for the 17 cultivars evaluated in 47 trials are shown in Tables 12 and 13 respectively. Tables 11, 12 and 13 should be used jointly for cultivar selection.

Acknowledgements

Funding from the Oil and Protein Seed Development Trust and the participation of Agricol, Pannar, Pioneer, Syngenta, Like seed, Sensako and University of the Free State gratefully acknowledged.

References

LOUBSER, H.L. & GRIMBEEK, C.L., 1984. Cultivarevaluasie: ‘n vergelyking tussen verskillende tegnieke. In: Notule van vergadering gehou deur die ondersoekkomitee na cultivarprogramme by die NIGG te Potchefstroom.

Table 1: **Cultivars evaluated, seed germinated rate and supplier's company 2019/20**

Cultivar's Name	Germinated (%)			
	Normal	Abnormal	Dormant/dead	Company
AGSUN 5101 CLP	94	1	5	Agricol
AGSUN 5102 CLP	97	0	3	
AGSUN 5103 CLP	98	2	0	
AGSUN 5106 CLP	97	2	1	
AGSUN 5270	97	1	2	
AGSUN 5273	98	0	2	
AGSUN 5278	100	0	0	
AGSUN 8251	99	0	1	
LG 5626 HO	86	9	5	Link Seed
LG 5678 CLP	99	1	0	
LG 5710	93	5	2	
P 64 LL 23	92	4	4	Pioneer
P 65 LL 02	84	6	10	
P 65 LL14	96	2	2	
P 65 LP 54	97	2	1	
PAN 7080	95	3	2	Pannar
PAN 7100	88	9	3	
PAN 7102 CLP	97	2	1	
PAN 7156 CLP	98	1	1	
PAN 7160 CLP	97	2	1	
PAN 7170	97	1	2	
RN 28485	94	1	5	Syngenta
RN 28584	97	1	2	
SY 3970 CL	95	2	3	
SY 3975 CLHO	95	2	3	
SY Arizona	97	3	0	

Table 2: Collaborating company, trial localities and responsible co-workers 2019/20

Company	Localities	Planting dates	Co-workers	E-mail address of co-worker
Agricol	Boskop 1	30/10/2019	Joubert Swanepoel	Jouberts@agricol.co.za
	Boskop 2	19/11/2019		
	Boskop 3	17/12/2019		
	Fochville	13/01/2020		
	Delpan	18/12/2019		
	Bothaville	19/12/2019		
	Makwassie	20/12/2019		
	Lichtenburg	06/01/2020		
	Wolmaranstad	14/01/2020		
	Leeudoringstad	15/01/2020		
	Ventersdorp	15/01/2020		
	Sannieshof	16/01/2020		
	Kroonstad	22/01/2020		
ARC-GCI	Potchefstroom	04/11/2019	William Makgoga & Jan Erasmus	Makgogamw@arc.agric.za Erasmusj@arc.agric.za
		21/11/2019		
		18/12/2019		
		23/01/2020		
		05/02/2020		
PANNAR	Potchefstroom	14/11/2019	Abre Pretorius & Louis Schoonraad	abre.pretorius@pannar.co.za louis.schoonraad@corteva.com
	Kroonstad Oos	19/12/2019		
	Kommandodrift	03/01/2020		
	Bethlehem	03/01/2020		
	Senekal	06/01/2020		
	Delmas	14/01/2020		
	Kroonstad Wes	15/01/2020		
Link seed	Henneman	17/01/2020	Werner Viljoen	Werner.viljoen@linkseed.co.za
	Kroonstad	17/01/2020		
	Sannieshof	24/01/2020		
Syngenta	Valsrivier	03/01/2020	Roean Wessels	roean.wessels@sensako.co.za Janco.Theunissen@syngenta.com
	Bothaville	02/01/2020		
	Settlers	13/02/2020		
	Kroonstad	Not planted		
	Excelsior	14/01/2020		
Pioneer	Putfontein	20/11/2019	Phillip Fourie	philip.fourie@pioneer.com
	Putfontein	21/11/2019		
	Gerdau	18/12/2019		
	Coligny	19/12/2019		

Table 3:Trial site information 2019/20 season

Locality	Planting date	Plant population	Soil classification	Top soil analysis (mg kg^{-1})					Fertiliser applied (Kg ha^{-1})	Row width (cm)	Weed control and insecticides	Net plot size (m^2)
				pH (KCl)	P	K	Ca	Mg				
Boskop 1	30/10/2019	40 000		-	-	-	-	-	-	91	Alanex and Karate	11.83
Boskop 2	19/11/2019	40 000	-	-	-	-	-	-	-	91	Alanex and Karate	11.83
Boskop 3	17/12/2019	40 000	-	-	-	-	-	-	-	91	Alanex and Karate-	11.83
Bothaville	18/12/2019	40 000	-	-	-	-	-	-	-	91	Mechanical weeding -	11.83
Makwassie	19/12/2019	40 000	-	-	-	-	-	-	-	91	Mechanical weeding	11.83
Wolmaranstad	06/01/2020	40 000	-	-	-	-	-	-	-	91	Mechanical weeding	11.83
Leeudoringstad	14/01/2020	40 000	-	-	-	-	-	-	-	91	Mechanical weeding	11.83
Ventersdorp	15/01/2020	40 000	-	-	-	-	-	-	-	91	Mechanical weeding	11.83
Potchefstroom	04/11/2019	40 000	-	6,29	55	290	1033	475	N:98,P:8.3.K:4.1	90	Frontier Optima and Gramaxome	14.40
Potchefstroom	21/11/2019	40 000	-	6,67	74	303	1095	573	N:105,P:8.3.K:4.1	90	Metagen Gold and Gramaxone	12.60
Potchefstroom	18/12/2019	40 000	-	6,67	74	303	1095	573	N:105,P:8.3.K:4.1	90	Metagen Gold and Gramaxome	12.60
Potchefstroom	23/01/2020	40 000	-	6,26	23	185	1093	468	N:108,P:8.3.K:4.1	90	Frontier Optima and Gramaxome	12.60
Potchefstroom	05/02/2020	40 000	-	6.26	23	185	1093	468	N:108,P:8.3,K:4.1	90	Frontier Optima and Gramaxome	12.60
Valsrivier	03/01/2020	40 000	-	-	-	-	-	-	-	91	-	12.74
Kroonstad	17/01/2020	40 000	-	-	-	-	-	-	-	-	-	10.92
Sannieshof	16/01/2020	40 000	-	-	-	-	-	-	-	-	-	10.92
Kroonstad Oos	19/12/2019	40 000	-	-	-	-	-	-	-	-	-	13.65
Kommandodrift	03/01/2020	40 000	-	-	-	-	-	-	-	-	-	13.65
Senekal	06/01/2020	40 000	-	-	-	-	-	-	-	-	-	13.65
Fochvile	13/01/2020	40 000	-	-	-	-	-	-	-	-		13.65
Kroonstad Wes	15/01/2020	40 000	-	-	-	-	-	-	-	-	-	13.65
Gerdau	18/12/2019	40 000	-	-	-	-	-	-	-	-	-	13.65
Coligny	19/12/2019	40 000	-	-	-	-	-	-	-	-	-	13.65
Marquard		40 000	-	-	-	-	-	-	-	-	-	13.65

Table 4: Number of days from planting to 50 percent flowering of cultivars at selected localities and planting dates 2019/2020

Cultivar	Boskop 2019/10/30	Boskop 2019/11/19	Boskop 02019/12/17	Leeudoringstad 2020/01/14	Fochville 2020/01/13	Makwassie 2019/12/19	Sannieshof 2020/01/16	Wolmaransstad 2020/01/06	Ventersdorp 2020/01/15	Potchefstroom 04/11/2019	Potchefstroom 21/11/2019	Potchefstroom 18/12/2019	Potchefstroom 05/02/2020	Mean
AGSUN 5101 CLP	75	70	67	69	75	64	69	69	68	71	63	64	81	70
AGSUN 5102 CLP	73	70	67	69	78	65	69	69	68	74	64	67	85	71
AGSUN 5103 CLP	75	71	68	70	75	62	70	70	69	74	67	67	81	71
AGSUN 5106 CLP	76	72	69	69	77	60	70	70	68	73	64	69	84	71
AGSUN 5270	69	70	65	67	70	62	67	67	66	70	63	67	73	67
AGSUN 5273	68	69	68	67	78	60	70	70	66	73	67	70	79	70
AGSUN 5278	73	71	67	68	76	61	69	69	67	73	63	64	80	69
AGSUN 8251	72	70	67	68	73	64	70	70	67	73	63	65	80	69
LG 5626 HO	75	72	66	65	68	64	68	68	64	69	59	61	74	67
LG 5678 CLP	72	72	66	68	75	60	69	69	67	73	66	67	85	70
LG 5710	75	70	68	67	73	63	69	69	66	71	62	61	80	69
P 64 LL 23	73	67	60	67	70	64	66	66	66	70	61	63	80	67
P 65 LL 02	75	69	64	68	75	65	68	68	67	73	64	70	77	69
P 65 LL 14	75	68	67	68	76	65	70	70	67	72	63	66	81	70
P 65 LP 54	71	69	62	69	75	65	69	69	68	72	63	65	75	69
PAN 7080	72	70	67	71	74	65	71	71	70	74	66	69	83	71
PAN 7100	73	69	69	67	72	65	69	69	66	73	63	68	78	69
PAN 7102 CLP	73	68	67	68	71	65	69	69	67	68	60	64	80	68
PAN 7156 CLP	71	68	68	69	77	63	70	70	68	69	67	69	81	70
PAN 7160 CLP	70	68	69	68	76	65	71	71	67	70	67	69	80	70
PAN 7170	70	69	68	68	74	63	71	71	67	71	64	67	78	69
RN 28485	70	66	60	65	71	61	67	67	64	68	61	62	72	66
RN 28584	72	67	62	68	73	65	68	68	67	71	60	61	75	67
SY 3970 CL	72	72	68	68	74	60	67	67	67	72	65	69	79	69
SY 3975 CLHO	76	72	66	70	77	61	71	71	69	73	67	69	79	71
SY Arizona	69	67	60	68	72	62	68	68	67	74	60	64	78	67
Mean	73	69	66	68	74	63	69	69	67	72	64	66	79	69

Table 5: The moisture free seed oil concentration (%) of cultivars at selected localities 2019/2020

Cultivar	Boskop 2019/10/30	Boskop 02019/12/17	Leeudoringstad 2020/01/14	Kroonstad 22/01/20	Fochville 2020/01/13	Sannieshof 2020/01/16	Wolmaransstad 2020/01/06	Ventersdorp 2020/01/15	Potchefstroom 04/11/2019	Potchefstroom 18/12/2019	Potchefstroom 05/02/2020	Mean
AGSUN 5101 CLP	37,57	40,49	39,99	34,84	39,05	38,65	35,23	35,96	41,14	39,00	32,16	37,64
AGSUN 5102 CLP	37,83	40,13	39,19	34,42	39,12	37,55	36,82	36,92	41,21	41,88	32,35	37,95
AGSUN 5103 CLP	38,21	40,59	39,33	33,68	38,80	37,46	37,10	35,94	40,95	42,25	32,60	37,90
AGSUN 5106 CLP	38,08	40,04	40,32	34,16	39,60	36,97	35,79	33,83	41,48	42,99	30,54	37,62
AGSUN 5270	38,15	43,31	44,11	36,23	45,96	44,24	42,41	38,91	43,69	45,46	41,34	42,17
AGSUN 5273	38,64	39,84	41,19	32,51	40,98	39,38	39,76	36,68	41,14	44,75	34,94	39,07
AGSUN 5278	38,70	42,44	41,38	32,11	41,38	40,95	38,20	36,04	41,36	42,25	30,37	38,65
AGSUN 8251	35,63	41,01	40,32	31,63	41,51	41,18	38,04	36,64	40,35	42,13	31,61	38,19
LG 5626 HO	42,23	45,85	44,64	46,02	46,68	45,39	45,46	42,27	47,92	47,63	41,01	45,01
LG 5678 CLP	46,13	48,60	46,21	42,74	49,47	45,23	48,10	43,46	48,89	50,21	38,65	46,15
LG 5710	45,38	48,87	46,55	41,00	50,57	49,61	47,10	45,79	50,07	49,60	40,84	46,85
P 64 LL 23	43,75	43,94	44,80	37,49	46,57	47,94	44,01	42,87	46,75	47,37	38,70	44,02
P 65 LL 02	40,68	42,43	43,81	36,58	44,47	43,35	42,15	40,74	45,71	48,75	41,32	42,73
P 65 LL 14	38,97	40,96	40,56	32,72	42,90	42,91	40,32	32,96	45,77	46,81	35,57	40,04
P 65 LP 54	35,96	38,07	37,57	34,81	40,27	38,92	38,28	35,03	39,76	42,81	35,93	37,95
PAN 7080	35,40	38,88	40,50	33,22	42,92	43,06	38,37	32,23	44,57	42,34	32,65	38,56
PAN 7100	40,27	43,58	42,80	36,67	45,27	43,89	41,30	40,22	44,81	46,70	38,35	42,17
PAN 7102 CLP	38,22	39,23	39,80	34,10	42,53	40,28	38,67	35,86	42,67	42,38	35,92	39,06
PAN 7156 CLP	35,65	39,81	39,96	35,56	41,63	39,79	38,41	36,74	40,60	44,62	34,25	38,82
PAN 7160 CLP	38,27	43,70	40,93	37,20	44,67	43,16	39,34	38,54	43,95	46,07	37,44	41,21
PAN 7170	38,84	41,48	42,81	37,16	46,96	43,34	39,24	39,40	45,94	46,69	38,90	41,89
RN 28485	46,71	47,15	49,60	40,82	50,76	50,26	48,26	47,70	50,66	44,68	46,90	47,59
RN 28584	47,28	48,85	48,98	43,92	54,00	52,11	49,53	46,30	50,55	51,08	39,37	48,36
SY 3970 CL	54,90	51,48	51,62	44,18	55,96	52,84	48,28	48,72	52,82	54,37	41,54	50,61
SY 3975 CLHO	49,24	46,76	48,27	41,62	50,55	50,54	45,88	43,15	54,74	51,45	37,14	47,21
SY Arizona	42,99	44,94	45,70	37,68	48,67	48,62	47,89	43,49	48,76	49,09	36,82	44,97
Mean	40,91	43,17	43,11	38,23	45,05	43,76	41,69	39,48	45,24	45,90	36,82	42,12

Table 6: The moisture free seed protein concentration (%) of cultivars at selected localities 2019/2020

Cultivar	Boskop 2019/10/30	Boskop 02019/12/17	Leeudoringstad 2020/01/14	Kroonstad 22/01/20	Fochville 2020/01/13	Sannieshof 2020/01/16	Wolmaransstad 2020/01/06	Ventersdorp 2020/01/15	Potchefstroom 04/11/2019	Potchefstroom 18/12/2019	Potchefstroom 05/02/2020	Mean
AGSUN 5101 CLP	21,16	17,72	19,68	19,26	17,95	18,06	21,97	22,25	13,03	16,27	18,38	18,70
AGSUN 5102 CLP	19,69	18,85	19,11	20,55	17,67	18,10	22,59	22,85	12,83	18,33	19,76	19,12
AGSUN 5103 CLP	17,91	16,71	19,59	18,28	16,92	17,84	20,69	22,13	12,94	15,93	17,63	17,87
AGSUN 5106 CLP	18,45	18,97	18,06	18,80	16,24	19,10	20,99	22,34	12,39	16,13	17,57	18,09
AGSUN 5270	21,46	17,37	16,47	15,86	15,28	16,45	18,91	20,73	14,31	15,42	15,77	17,09
AGSUN 5273	18,88	18,16	16,82	17,95	15,63	16,23	17,43	21,04	12,86	15,55	16,72	17,02
AGSUN 5278	20,11	17,18	17,77	18,30	15,82	15,08	19,13	20,75	13,09	15,76	17,88	17,35
AGSUN 8251	18,51	16,29	17,70	17,73	15,46	15,43	17,89	21,05	12,56	16,62	16,92	16,92
LG 5626 HO	19,47	17,16	18,56	17,79	16,02	16,26	17,99	20,08	13,95	17,60	19,52	17,67
LG 5678 CLP	20,06	16,38	18,63	17,45	16,00	16,65	16,66	20,88	14,57	17,22	18,38	17,53
LG 5710	20,91	17,33	20,38	17,84	16,15	15,71	19,58	21,19	13,93	17,76	20,01	18,25
P 64 LL 23	16,31	17,25	17,00	16,37	15,09	14,26	16,70	20,48	11,43	14,66	15,89	15,95
P 65 LL 02	17,82	18,27	16,10	17,19	14,94	13,92	15,86	19,98	12,22	13,32	16,16	15,98
P 65 LL 14	19,27	18,25	17,30	19,06	15,44	12,30	15,85	20,21	11,69	14,02	16,69	16,37
P 65 LP 54	20,13	18,70	17,46	18,21	14,17	14,43	16,31	22,60	12,84	14,40	16,74	16,91
PAN 7080	18,37	18,21	17,54	21,96	13,16	11,52	15,81	20,86	11,04	12,95	16,90	16,21
PAN 7100	18,34	17,42	16,21	19,78	13,96	12,33	15,85	18,71	11,59	15,54	15,86	15,96
PAN 7102 CLP	18,12	17,64	16,68	16,93	13,68	14,42	16,53	20,12	12,33	13,91	15,87	16,02
PAN 7156 CLP	20,96	18,45	17,05	17,89	14,14	13,46	15,37	18,91	12,81	13,45	17,10	16,32
PAN 7160 CLP	20,12	17,00	16,57	17,40	13,89	13,03	16,26	20,64	12,02	14,63	15,42	16,09
PAN 7170	17,99	18,78	17,81	16,49	14,16	15,50	17,31	19,67	12,21	15,24	15,25	16,40
RN 28485	22,90	21,65	20,05	19,13	17,53	16,29	20,53	22,00	15,97	19,35	19,81	19,56
RN 28584	19,98	19,23	18,76	18,24	13,54	13,51	17,87	19,63	14,15	18,14	17,99	17,37
SY 3970 CL	17,39	17,59	17,57	23,05	13,85	14,49	18,38	20,94	11,74	15,46	19,90	17,30
SY 3975 CLHO	19,23	20,73	19,82	20,67	16,24	14,45	18,67	21,38	12,22	18,04	19,66	18,28
SY Arizona	18,85	17,15	19,14	18,12	15,36	14,41	15,46	19,77	12,35	15,74	17,79	16,74
Mean	19,32	18,02	17,99	18,47	15,32	15,12	17,95	20,82	12,81	15,82	17,52	17,20

Table 7: Mean seed yield (t ha^{-1}) of cultivars at each locality 2019/2020

Cultivar /Locality	Boskop1 30/10/2019	Boskop2 19/11/2019	Boskop3 17/12/2019	Fochville 13/01/2020	Kroonstad 17/1/20	Kroonstad 22/01/2020	Kroonstad Oos	Kroonstad Wes	Leeudoringstad 14/01/2020	Makwassie 19/12/2019	Marquard	Potchefstroom 18/12/2019	Potchefstroom 23/01/2020	Potchefstroom 04/11/2019	Potchefstroom 05/02/2020	Potchefstroom 29/11/2019	Sannieshof 16/01/2020	Senekal	Valsrivier 3/01/2020	Ventersdorp 15/01/2020	Wolmaranstad 06/01/2020	Mean
AGSUN 5101 CLP	3,63	3,18	2,96	2,08	3,71	1,65	3,27	2,05	2,57	3,02	1,71	2,76	1,92	2,21	0,71	2,68	1,80	1,91	2,84	3,03	2,98	2,51
AGSUN 5102 CLP	3,43	3,58	3,21	2,24	3,48	1,56	3,14	2,07	3,34	2,92	1,78	2,61	1,48	2,30	0,72	2,74	1,96	2,25	2,67	3,44	3,21	2,58
AGSUN 5103 CLP	3,85	3,34	2,96	2,25	3,76	1,55	3,58	2,33	3,24	2,70	1,44	2,88	1,71	2,24	0,76	2,70	2,23	2,61	2,24	3,45	3,39	2,63
AGSUN 5106 CLP	3,45	3,32	2,73	2,06	3,84	1,45	3,33	2,25	3,77	3,03	1,65	2,83	1,90	2,26	0,52	2,54	2,20	2,46	2,39	3,37	3,64	2,62
AGSUN 5270	3,05	3,87	2,92	2,55	3,06	2,16	3,46	1,61	3,41	3,35	1,80	2,99	2,24	2,06	1,64	2,77	1,96	2,20	2,49	2,79	3,48	2,66
AGSU N5273	3,34	2,46	2,39	1,80	3,44	1,44	2,79	2,24	3,12	3,67	1,24	2,69	2,27	2,19	1,20	2,60	1,34	2,18	2,17	2,68	2,99	2,39
AGSU N5278	3,30	3,78	3,06	2,52	3,70	1,52	3,05	2,30	3,11	2,60	1,76	2,77	1,93	2,17	0,88	2,90	1,91	2,54	2,36	3,53	3,11	2,61
AGSUN 8251	3,21	3,26	2,94	2,68	4,15	1,62	3,24	1,93	3,42	3,17	1,32	2,74	1,98	2,18	0,83	2,83	1,99	2,17	2,31	3,24	3,45	2,60
LG 5626 HO	3,32	2,71	2,46	2,03	2,89	1,37	2,80	1,59	2,56	2,02	1,24	2,95	2,01	2,27	0,97	2,83	1,28	1,57	1,73	2,40	1,95	2,14
LG 5678 CLP	2,71	2,73	2,82	2,26	3,07	1,33	3,21	1,84	2,58	2,24	1,77	2,87	1,44	2,30	0,41	2,59	1,20	1,75	2,22	2,37	2,92	2,22
LG 5710	3,21	3,33	3,18	1,85	3,03	1,19	2,87	1,78	2,48	2,34	1,38	2,92	1,98	2,55	0,71	3,12	1,87	2,74	2,28	2,57	2,29	2,37
P 64 L L23	3,66	4,02	2,76	2,40	4,16	1,76	2,81	2,12	3,36	3,02	1,61	3,40	2,54	2,63	1,15	3,18	1,98	1,44	2,42	3,00	3,06	2,69
P 65 LL 02	2,89	3,05	2,84	2,08	4,22	1,38	2,59	1,10	3,11	3,72	1,27	3,45	2,33	2,67	1,37	2,92	1,74	1,69	2,60	3,26	3,02	2,54
P 65 LL 14	2,88	2,76	2,27	2,34	3,86	1,20	3,13	2,13	3,44	3,06	1,61	3,24	2,38	2,45	0,80	3,03	1,79	2,50	2,47	3,19	3,47	2,57
P65 LP 54	2,72	2,65	2,83	2,55	3,77	1,56	2,76	2,14	2,87	2,73	1,79	3,25	2,36	2,77	0,61	3,03	1,95	2,11	2,85	2,67	3,59	2,55
PAN 7080	3,35	3,36	2,97	2,13	4,08	1,37	3,01	2,40	3,05	3,38	1,41	3,39	2,18	2,59	0,65	2,90	1,94	2,54	2,81	3,33	3,46	2,68
PAN 7100	3,09	3,37	2,98	2,10	4,17	1,43	2,81	2,21	3,00	3,29	1,59	3,15	2,49	2,51	1,15	2,81	1,74	2,73	2,57	2,99	3,41	2,65
PAN 7102 CLP	2,81	3,48	2,97	2,32	3,60	1,62	2,82	2,12	2,56	3,26	1,30	3,20	2,44	2,43	1,15	2,97	2,09	2,29	2,38	2,97	3,08	2,56
PAN 7156 CLP	2,95	3,46	3,13	2,75	3,91	1,54	3,73	2,24	3,52	3,55	1,65	3,40	2,14	2,55	0,84	2,84	2,18	2,66	2,73	3,42	3,25	2,78
PAN 7160 CLP	3,37	3,13	3,06	2,31	3,89	1,39	3,32	2,05	3,39	3,25	1,66	3,04	1,92	2,52	0,80	3,03	1,84	2,69	2,87	2,90	3,40	2,66
PAN 7170	3,10	3,49	2,94	2,04	4,08	1,20	2,77	2,26	3,38	3,09	1,72	3,13	2,36	2,55	1,23	3,12	1,82	2,61	2,63	2,76	3,05	2,63
RN 28485	3,31	2,64	2,66	1,57	2,78	1,35	2,83	1,52	2,48	2,48	1,30	2,86	2,13	2,30	1,52	2,81	1,70	2,20	2,13	2,26	2,60	2,26
RN 28584	3,43	3,42	2,71	1,87	2,55	1,11	2,34	1,83	2,45	1,84	1,50	2,96	1,90	2,59	0,44	2,62	1,75	2,87	2,19	2,97	2,84	2,29
SY 3970 CL	3,10	2,16	2,59	2,28	3,15	1,30	3,44	2,03	2,68	2,89	1,83	3,03	1,53	2,29	0,59	2,78	1,80	2,06	2,32	2,48	2,78	2,34
SY 3975 CLHO	3,28	2,28	2,29	1,79	3,11	1,00	3,21	1,84	2,29	2,64	1,81	2,63	1,60	2,15	0,58	2,70	1,84	2,39	2,39	1,92	2,17	2,19
SYArizona	3,32	2,58	2,51	1,75	2,04	1,46	3,40	1,51	2,25	2,39	1,56	2,99	2,22	2,20	0,98	2,49	1,80	1,85	2,22	3,28	2,37	2,25
Mean	3,22	3,13	2,81	2,18	3,52	1,44	3,07	1,98	2,98	2,91	1,57	3,00	2,05	2,38	0,89	2,83	1,83	2,27	2,43	2,93	3,04	2,50
Cv%	15,60	12,70	11,70	14,70	10,40	18,30	11,30	12,30	14,70	14,00	17,30	7,30	7,90	10,10	16,60	7,60	13,20	15,80	12,70	12,50	12,80	

Table 8: Oil yield (t ha^{-1}) of cultivars at selected localities 2019/2020

Cultivar	Boskop 2019/10/30	Boskop 02019/12/17	Leeudoringstad 2020/01/14	Kroonstad 22/01/20	Fochville 2020/01/13	Sannieshof 2020/01/16	Wolmaransstad 2020/01/06	Ventersdorp 2020/01/15	Potchefstroom 04/11/2019	Potchefstroom 18/12/2019	Potchefstroom 05/02/2020	Mean
AGSUN 5101 CLP	1,36	1,20	1,03	0,57	0,81	0,70	1,05	1,09	0,91	1,08	0,23	0,91
AGSUN 5102 CLP	1,30	1,29	1,31	0,54	0,88	0,74	1,18	1,27	0,95	1,09	0,23	0,98
AGSUN 5103 CLP	1,47	1,20	1,27	0,52	0,87	0,84	1,26	1,24	0,92	1,22	0,25	1,01
AGSUN 5106 CLP	1,31	1,09	1,52	0,50	0,82	0,81	1,30	1,14	0,94	1,22	0,16	0,98
AGSUN 5270	1,16	1,26	1,50	0,78	1,17	0,87	1,48	1,09	0,90	1,36	0,68	1,11
AGSUN 5273	1,29	0,95	1,29	0,47	0,74	0,53	1,19	0,98	0,90	1,20	0,42	0,91
AGSUN 5278	1,28	1,30	1,29	0,49	1,04	0,78	1,19	1,27	0,90	1,17	0,27	1,00
AGSUN 8251	1,14	1,21	1,38	0,51	1,11	0,82	1,31	1,19	0,88	1,15	0,26	1,00
LG 5626 HO	1,40	1,13	1,14	0,63	0,95	0,58	0,89	1,01	1,09	1,40	0,40	0,97
LG 5678 CLP	1,25	1,37	1,19	0,57	1,12	0,54	1,40	1,03	1,12	1,44	0,16	1,02
LG 5710	1,46	1,55	1,15	0,49	0,94	0,93	1,08	1,18	1,28	1,45	0,29	1,07
P 64 LL 23	1,60	1,21	1,51	0,66	1,12	0,95	1,35	1,29	1,23	1,61	0,45	1,18
P 65 LL 02	1,18	1,20	1,36	0,50	0,92	0,75	1,27	1,33	1,22	1,68	0,57	1,09
P 65 LL 14	1,12	0,93	1,40	0,39	1,00	0,77	1,40	1,05	1,12	1,52	0,28	1,00
P 65 LP 54	0,98	1,08	1,08	0,54	1,03	0,76	1,37	0,94	1,10	1,39	0,22	0,95
PAN 7080	1,19	1,15	1,24	0,46	0,91	0,84	1,33	1,07	1,15	1,44	0,21	1,00
PAN 7100	1,24	1,30	1,28	0,52	0,95	0,76	1,41	1,20	1,12	1,47	0,44	1,06
PAN 7102 CLP	1,07	1,17	1,02	0,55	0,99	0,84	1,19	1,06	1,04	1,36	0,41	0,97
PAN 7156 CLP	1,05	1,25	1,41	0,55	1,14	0,87	1,25	1,26	1,04	1,52	0,29	1,06
PAN 7160 CLP	1,29	1,34	1,39	0,52	1,03	0,79	1,34	1,12	1,11	1,40	0,30	1,06
PAN 7170	1,20	1,22	1,45	0,45	0,96	0,79	1,20	1,09	1,17	1,46	0,48	1,04
RN 28485	1,55	1,25	1,23	0,55	0,80	0,85	1,25	1,08	1,17	1,28	0,71	1,07
RN 28584	1,62	1,32	1,20	0,49	1,01	0,91	1,41	1,38	1,31	1,51	0,17	1,12
SY 3970 CL	1,70	1,33	1,38	0,57	1,28	0,95	1,34	1,21	1,21	1,65	0,25	1,17
SY 3975 CLHO	1,62	1,07	1,11	0,42	0,90	0,93	1,00	0,83	1,18	1,35	0,22	0,96
SY Arizona	1,43	1,13	1,03	0,55	0,85	0,88	1,14	1,43	1,07	1,47	0,36	1,03
Mean	1,36	1,20	1,03	0,57	0,81	0,70	1,05	1,09	0,91	1,08	0,23	0,91

Table 9: Parameters calculated from the analysis of variance for yield data at each locality

Locality	Mean (t/ha)	SE	CV (%)	GCV	t	SE(t)	tn
Boskop1 30-10-2019	3,22	0,29	15,60	.	-0,01	0,11	-0,03
Boskop2 19-11-2019	3,13	0,23	12,70	13,90	0,55	0,11	0,79
Boskop3 17-12-2019	2,81	0,19	11,70	6,40	0,23	0,13	0,47
Bothaville 02-01-2020	2,10	0,25	20,60	6,30	0,08	0,12	0,21
Coligny	1,86	0,30	27,60	13,30	0,19	0,13	0,41
Fochville 13-01-2020	2,18	0,19	14,70	10,80	0,35	0,13	0,62
Gerdau	1,46	0,30	35,70	23,00	0,29	0,13	0,55
Kommandodrif	1,90	0,33	30,30	22,10	0,35	0,13	0,62
Kroonstad 17-01-2020	3,52	0,21	10,40	15,00	0,67	0,09	0,86
Kroonsatd 22-01-2020	1,44	0,15	18,30	11,90	0,30	0,13	0,56
KroonstadOos	3,07	0,20	11,30	8,60	0,37	0,13	0,64
KroonstadWes	1,98	0,14	12,30	14,20	0,57	0,11	0,80
Leeudoringstad 14-01-2020	2,98	0,25	14,70	12,00	0,40	0,13	0,67
Makwassie 19-12-2019	2,91	0,24	14,00	14,80	0,53	0,11	0,77
Marquard	1,57	0,16	17,30	8,00	0,18	0,13	0,40
Potchefstroom 18-12-2019	3,00	0,13	7,30	7,10	0,49	0,12	0,74
Potchefstroom 23-01-2020	2,05	0,09	7,90	14,80	0,78	0,07	0,91
Potchefstoom 04-11-2019	2,38	0,14	10,10	5,60	0,24	0,13	0,49
Potchefstroom 05-12-2020	0,89	0,09	16,60	35,10	0,82	0,06	0,93
Potchefstroom 21-11-2019	2,83	0,12	7,60	5,00	0,30	0,13	0,56
Sannieshof 16-01-2020	1,83	0,14	13,20	11,40	0,42	0,12	0,68
Senekal	2,27	0,21	15,80	14,50	0,46	0,12	0,72
Valsrivier 03-01-2020	2,43	0,18	12,70	8,30	0,30	0,13	0,56
Ventersdorp 15-01-2020	2,93	0,21	12,50	12,50	0,50	0,12	0,75
Wolmaranstad 06-01-2020	3,04	0,23	12,80	12,90	0,50	0,12	0,75

Table 10: Regression line coordinates at different yield potentials 2019/20

Cultivar	Yield potential (t ha^{-1})						Mean (t ha^{-1})	Intercept	Slope	Fprob	R^2
	1	1,5	2	2,5	3	3,5					
AGSUN 5101 CLP	0,93	1,46	1,98	2,51	3,03	3,56	2,51	-0,12	1,05	<0.001	0,91
AGSUN 5102 CLP	0,94	1,49	2,04	2,59	3,14	3,69	2,58	-0,16	1,10	<0.001	0,90
AGSUN 5103 CLP	0,91	1,49	2,06	2,64	3,21	3,79	2,63	-0,24	1,15	<0.001	0,90
AGSUN 5106 CLP	0,84	1,43	2,02	2,61	3,20	3,79	2,62	-0,34	1,18	<0.001	0,90
AGSUN 5270	1,41	1,83	2,24	2,66	3,07	3,49	2,66	0,58	0,83	<0.001	0,73
AGSU N5273	0,99	1,46	1,92	2,39	2,85	3,32	2,39	0,06	0,93	<0.001	0,79
AGSU N5278	1,06	1,58	2,09	2,61	3,12	3,64	2,61	0,03	1,03	<0.001	0,90
AGSUN 8251	0,88	1,46	2,03	2,61	3,18	3,76	2,60	-0,27	1,15	<0.001	0,91
LG 5626 HO	0,87	1,30	1,72	2,15	2,57	3,00	2,14	0,02	0,85	<0.001	0,78
LG 5678 CLP	0,77	1,25	1,73	2,21	2,69	3,17	2,22	-0,19	0,96	<0.001	0,86
LG 5710	0,95	1,42	1,89	2,36	2,83	3,30	2,37	0,01	0,94	<0.001	0,80
P 64 L L23	1,05	1,60	2,14	2,69	3,23	3,78	2,69	-0,04	1,09	<0.001	0,83
P 65 LL 02	0,87	1,43	1,98	2,54	3,09	3,65	2,54	-0,24	1,11	<0.001	0,78
P 65 LL 14	0,98	1,52	2,05	2,59	3,12	3,66	2,57	-0,09	1,07	<0.001	0,89
P65 LP 54	1,16	1,63	2,09	2,56	3,02	3,49	2,55	0,23	0,93	<0.001	0,81
PAN 7080	0,89	1,49	2,09	2,69	3,29	3,89	2,68	-0,31	1,20	<0.001	0,96
PAN 7100	1,10	1,62	2,13	2,65	3,16	3,68	2,65	0,07	1,03	<0.001	0,91
PAN 7102 CLP	1,20	1,66	2,12	2,58	3,04	3,50	2,56	0,28	0,92	<0.001	0,88
PAN 7156 CLP	1,10	1,66	2,22	2,78	3,34	3,90	2,78	-0,02	1,12	<0.001	0,92
PAN 7160 CLP	0,96	1,53	2,10	2,67	3,24	3,81	2,66	-0,18	1,14	<0.001	0,96
PAN 7170	1,11	1,62	2,13	2,64	3,15	3,66	2,63	0,09	1,02	<0.001	0,91
RN 28485	1,14	1,52	1,89	2,27	2,64	3,02	2,26	0,39	0,75	<0.001	0,79
RN 28584	0,91	1,38	1,84	2,31	2,77	3,24	2,29	-0,02	0,93	<0.001	0,72
SY 3970 CL	0,97	1,43	1,89	2,35	2,81	3,27	2,34	0,05	0,92	<0.001	0,84
SY 3975 CLHO	0,93	1,36	1,78	2,21	2,63	3,06	2,19	0,08	0,85	<0.001	0,75
SYArizona	1,11	1,49	1,86	2,24	2,61	2,99	2,25	0,36	0,75	<0.001	0,63

Table 11: Yield probability (%) of cultivars for 2019/20 at different yield potentials

Cultivar	Yield potential (t ha^{-1})						Regression line	
	1	1,5	2	2,5	3	3,5	Fprob	R2
AGSUN 5101 CLP	45	47	48	51	52	55	<0.001	0,91
AGSUN 5102 CLP	46	49	53	57	61	64	<0.001	0,89
AGSUN 5103 CLP	44	49	55	61	65	71	<0.001	0,89
AGSUN 5106 CLP	39	45	52	58	65	70	<0.001	0,90
AGSUN 5270	74	71	66	61	55	49	<0.001	0,73
AGSUN 5273	49	47	45	43	40	38	<0.001	0,80
AGSUN 5278	54	56	57	59	59	61	<0.001	0,90
AGSUN 8251	41	47	52	59	64	70	<0.001	0,92
LG 5626 HO	41	37	31	27	23	20	<0.001	0,78
LG 5678 CLP	34	32	31	29	28	27	<0.001	0,85
LG 5710	47	45	42	40	38	37	<0.001	0,81
P 64 LL 23	53	56	59	62	65	68	<0.001	0,83
P 65 LL 02	43	46	49	52	55	59	<0.001	0,74
P 65 LL 14	49	51	54	57	59	62	<0.001	0,88
P 65 LP 54	61	59	56	54	51	49	<0.001	0,81
PAN 7080	40	49	58	67	75	81	<0.001	0,96
PAN 7100	58	60	61	62	63	64	<0.001	0,91
PAN 7102 CLP	65	63	60	57	53	50	<0.001	0,88
PAN 7156 CLP	58	63	67	72	76	79	<0.001	0,89
PAN 7160 CLP	46	53	60	66	72	77	<0.001	0,96
PAN 7170	58	59	60	61	62	62	<0.001	0,90
RN 28485	60	51	42	33	25	19	<0.001	0,80
RN 28584	45	43	40	38	36	35	<0.001	0,73
SY 3970 CL	48	45	42	39	36	34	<0.001	0,83
SY 3975 CLHO	46	41	36	31	27	23	<0.001	0,76
SYArizona	57	49	41	34	27	22	<0.001	0,64

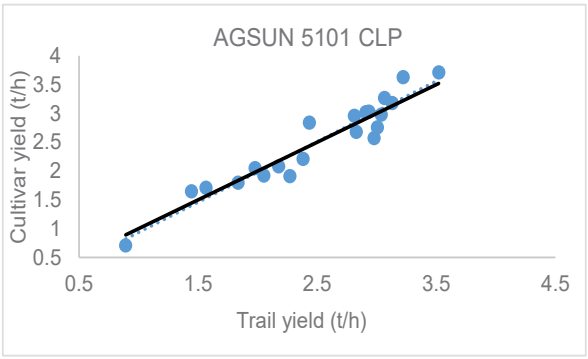
Table 12: Yield probability (%) of cultivars 2018/2019 and 2019/2020 at different yield potentials

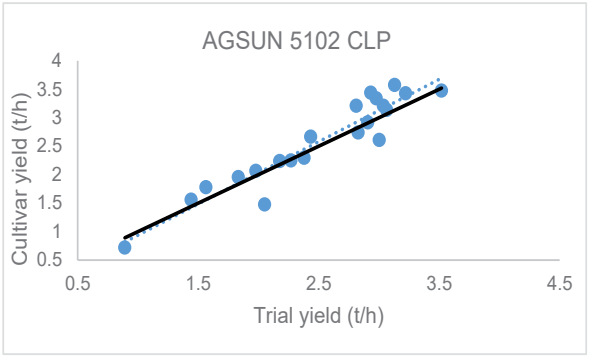
	Yield potential (t/ha)						Regression line	
	1	1,5	2	2,5	3	3,5	Fprob	R2
AGSUN 5101 CLP	45	46	46	47	47	48	<0.001	0,90
AGSUN 5102 CLP	46	48	48	50	51	52	<0.001	0,90
AGSUN 5103 CLP	42	47	51	56	60	64	<0.001	0,91
AGSUN 5106 CLP	34	42	49	58	65	72	<0.001	0,94
AGSUN 5270	69	66	63	59	56	52	<0.001	0,81
AGSUN 5273	45	44	41	40	38	37	<0.001	0,83
AGSUN 5278	47	48	48	49	49	49	<0.001	0,86
AGSUN 8251	56	57	58	59	60	61	<0.001	0,84
LG567 8CLP	39	36	33	30	28	25	<0.001	0,88
LG 5710	49	46	43	40	37	35	<0.001	0,80
P 64 LL 23	59	59	59	59	59	59	<0.001	0,81
P 65 LL 02	46	49	52	55	58	61	<0.001	0,82
P 65 LL 14	51	52	54	56	57	58	<0.001	0,89
P 65 LP 54	57	55	53	52	49	48	<0.001	0,86
PAN 7080	49	55	61	67	72	76	<0.001	0,93
PAN 7100	57	57	56	55	54	53	<0.001	0,91
PAN 7102 CLP	68	65	61	57	53	49	<0.001	0,88
PAN 7156 CLP	58	62	66	70	73	76	<0.001	0,93
PAN 7160 CLP	43	48	54	59	64	69	<0.001	0,95
SY 3970 CL	36	36	35	35	35	35	<0.001	0,86
SY 3975 CLOH	42	36	31	26	21	18	<0.001	0,79
SY Arizona	58	52	46	39	34	28	<0.001	0,66

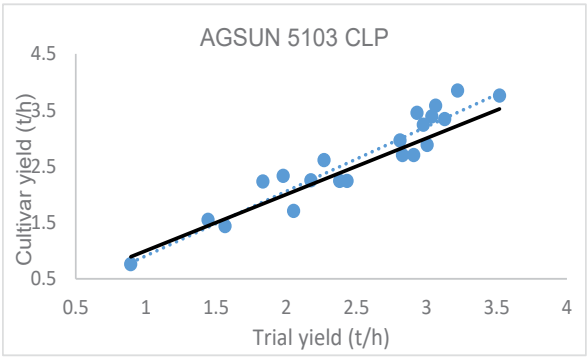
Table 13: Yield probability (%) of cultivars for three years' data 2017/18 to 2019/2020 at different yield potentials

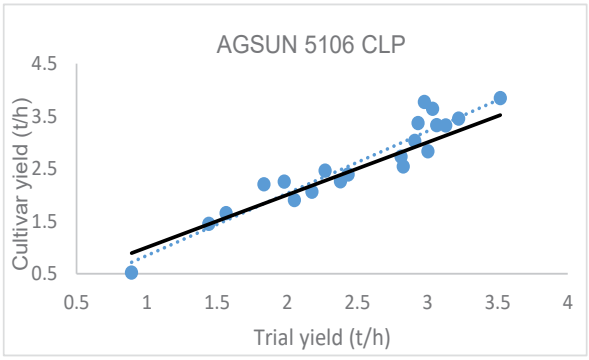
	Yield potential (t/ha)						Regression line	
	1	1,5	2	2,5	3	3,5	Fprob	R2
AGSUN5101CLP	41	41	41	41	41	41	<0.001	0,90
AGSUN5102CLP	44	44	43	43	42	42	<0.001	0,90
AGSUN5103CLP	40	44	48	53	57	61	<0.001	0,91
AGSUN5106CLP	41	46	50	55	59	64	<0.001	0,93
AGSUN5270	67	64	60	56	52	48	<0.001	0,81
AGSUN5273	47	44	40	37	33	31	<0.001	0,83
AGSUN5278	51	49	47	45	43	42	<0.001	0,86
AGSUN8251	55	55	54	54	54	54	<0.001	0,84
P65LL02	50	51	52	54	54	56	<0.001	0,88
P65LL14	52	52	52	53	53	54	<0.001	0,80
P65LP54	53	52	50	48	47	45	<0.001	0,81
PAN7160CLP	46	50	54	57	61	65	<0.001	0,82
PAN7080	44	50	55	61	66	71	<0.001	0,89
PAN7100	56	56	55	55	54	54	<0.001	0,86
PAN7102CLP	66	62	58	54	50	46	<0.001	0,93
PAN7156CLP	59	60	61	63	64	65	<0.001	0,91
SY3970CL	39	37	34	32	29	27	<0.001	0,88

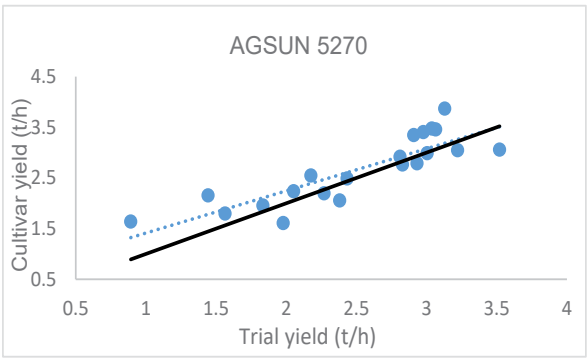
Figure 1: Regression lines for cultivars 2019/2020

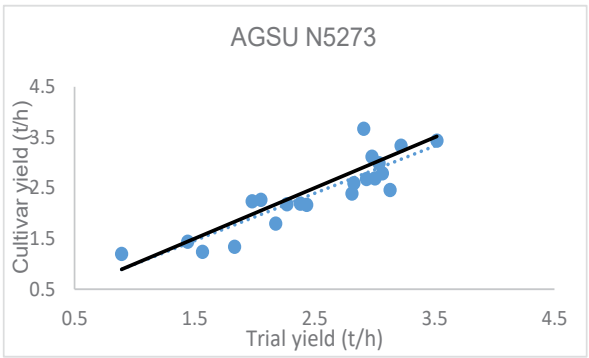


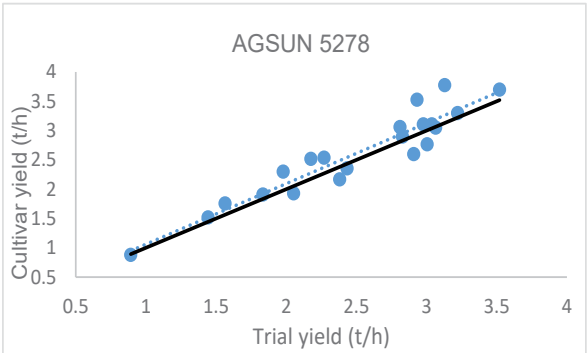


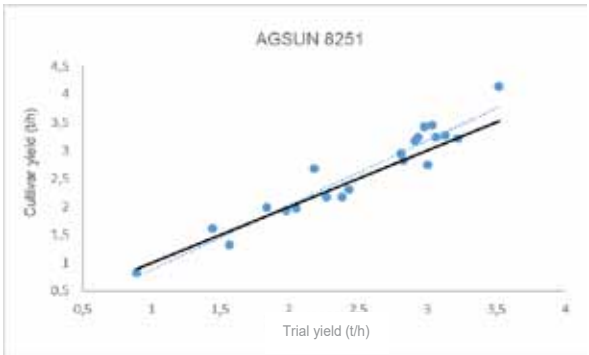












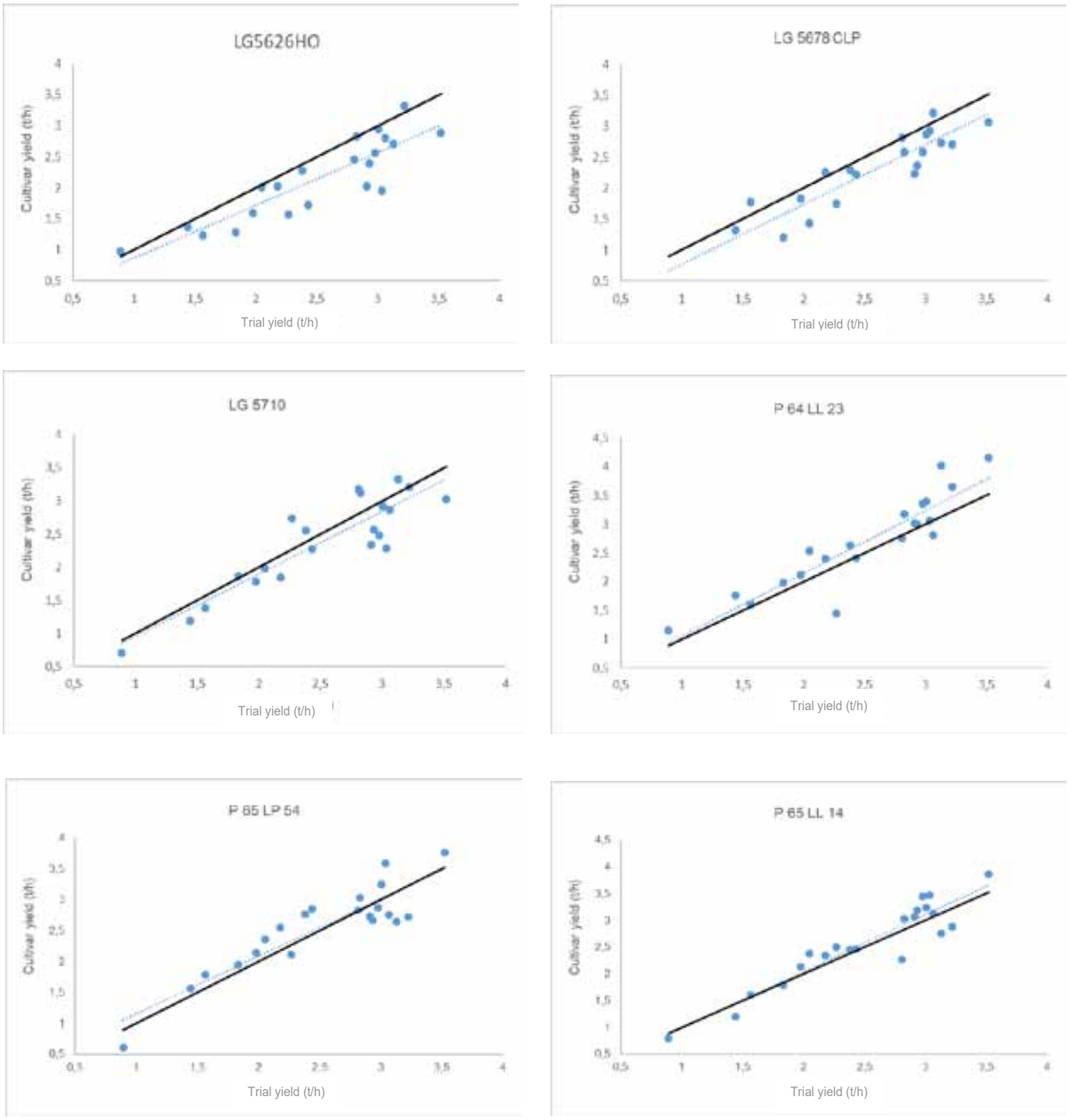
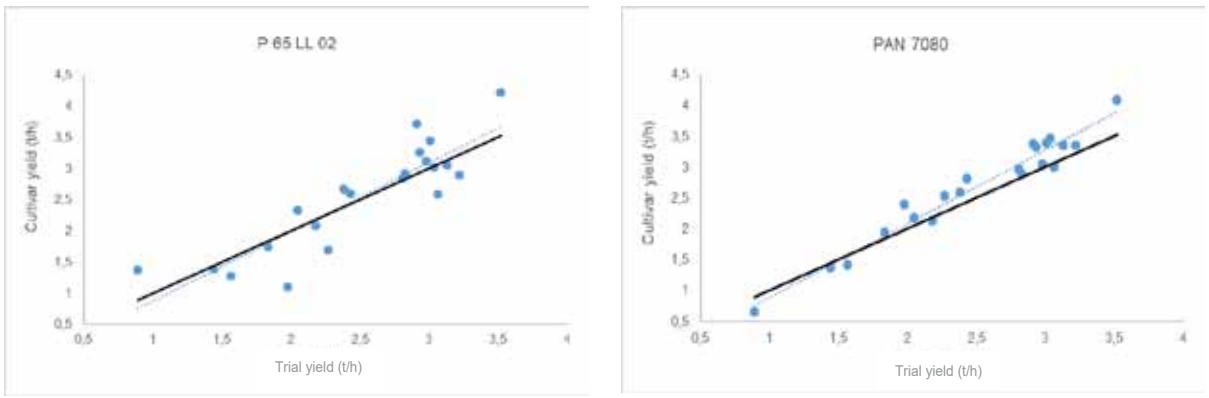
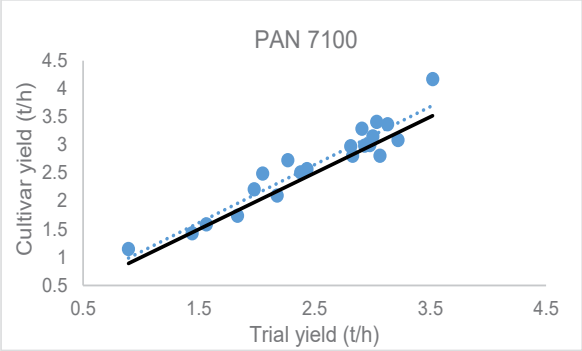
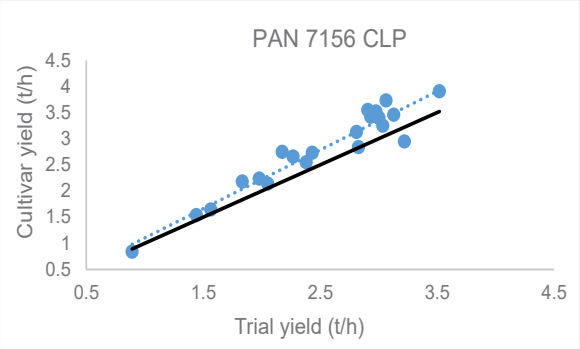
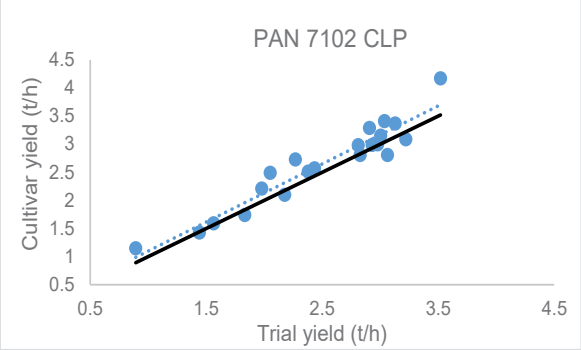


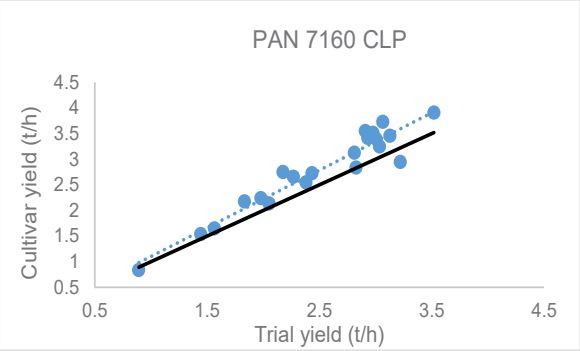
Figure 2: Regression lines for cultivars 2018/2019 and 2019/2020

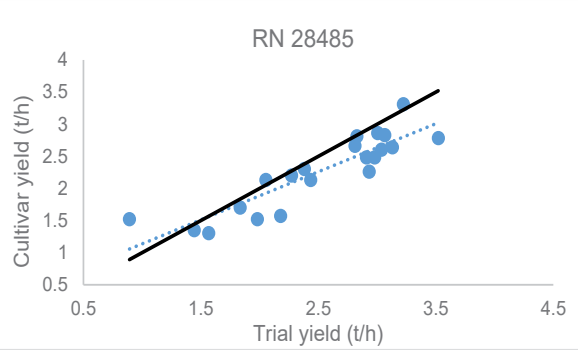


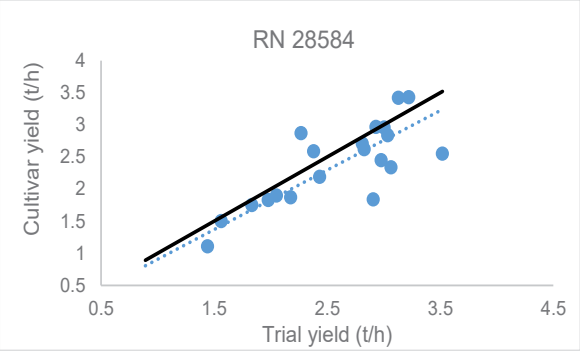

PAN 7100
Cultivar yield (t/h)
Trial yield (t/h)

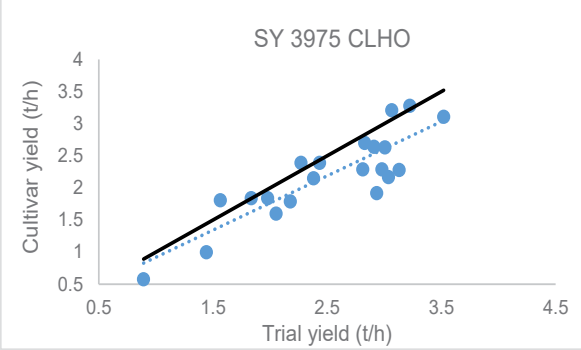

PAN 7156 CLP
Cultivar yield (t/h)
Trial yield (t/h)

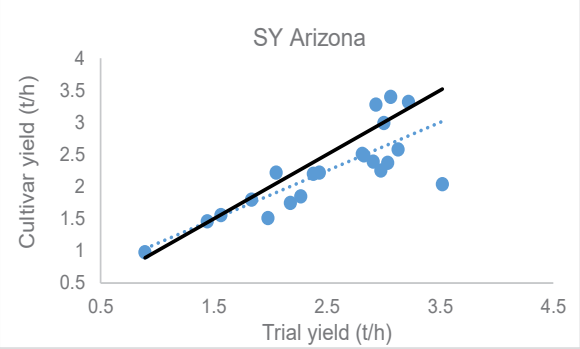

PAN 7102 CLP
Cultivar yield (t/h)
Trial yield (t/h)


PAN 7160 CLP
Cultivar yield (t/h)
Trial yield (t/h)


RN 28485
Cultivar yield (t/h)
Trial yield (t/h)


RN 28584
Cultivar yield (t/h)
Trial yield (t/h)


SY 3975 CLHO
Cultivar yield (t/h)
Trial yield (t/h)


SY Arizona
Cultivar yield (t/h)
Trial yield (t/h)

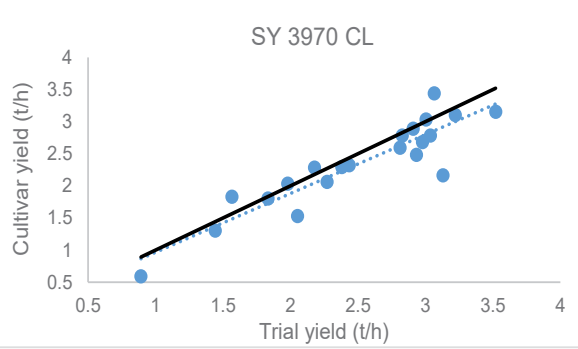
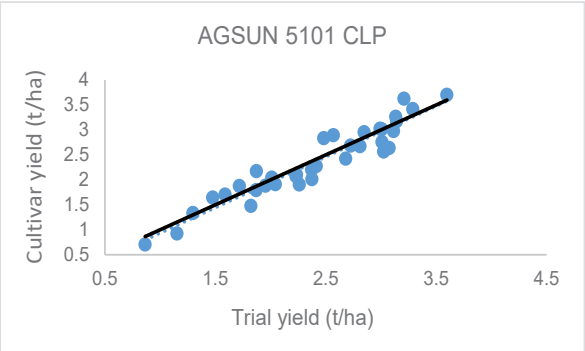
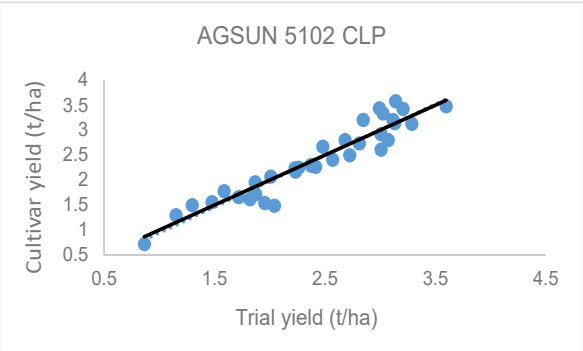
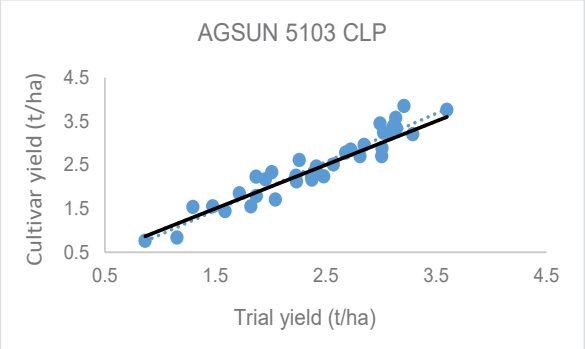
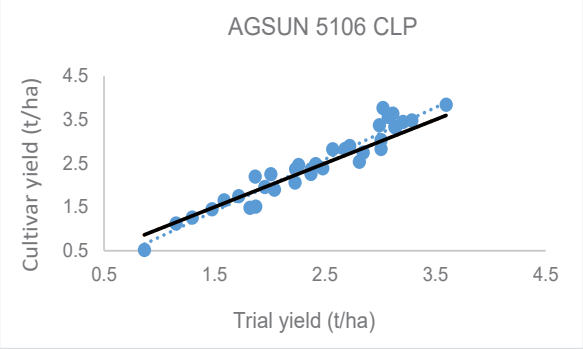

SY 3970 CL
Cultivar yield (t/h)
Trial yield (t/h)

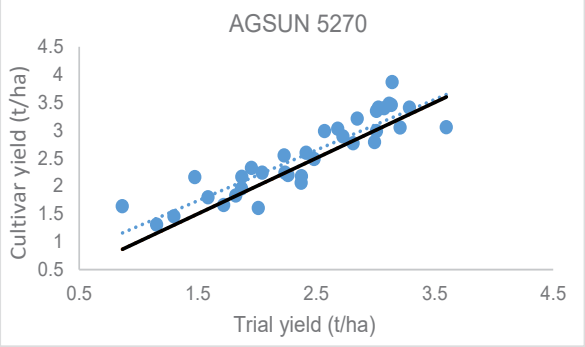
Figure 2: Regression lines for cultivars 2018/2019 – 2019/2020

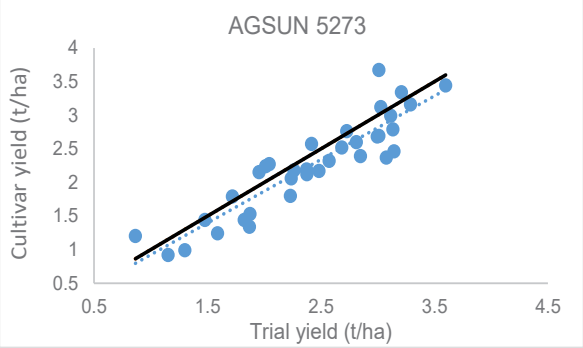


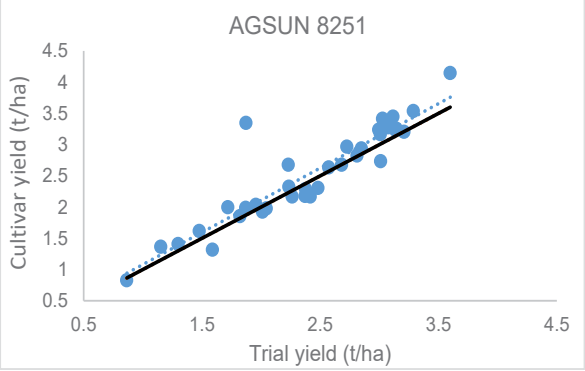


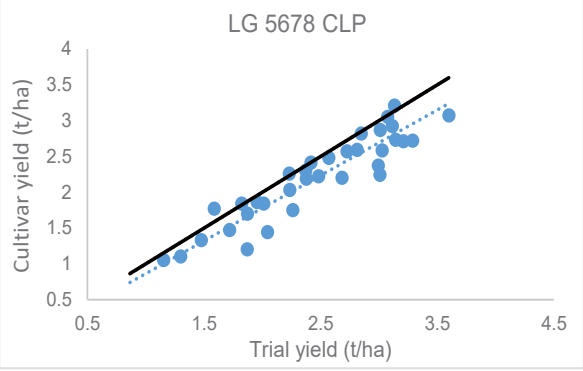


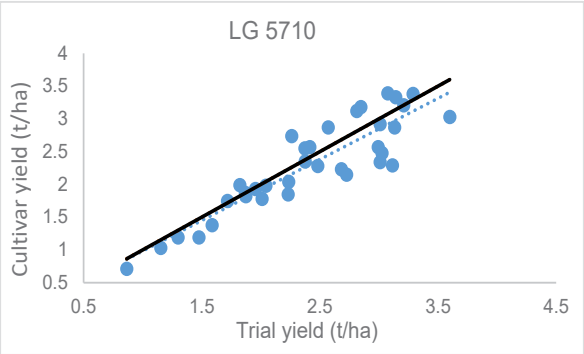


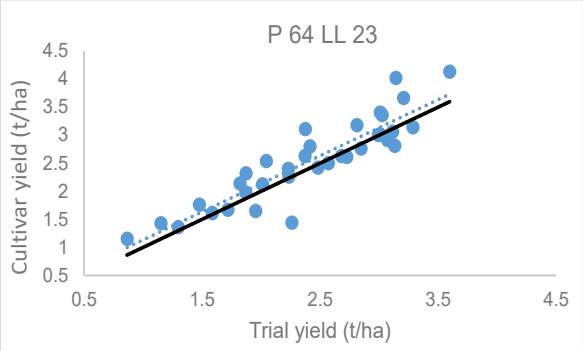


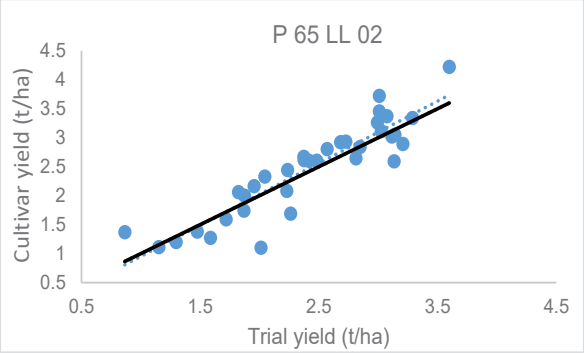


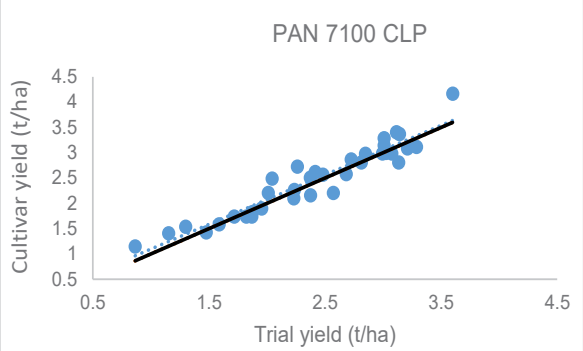


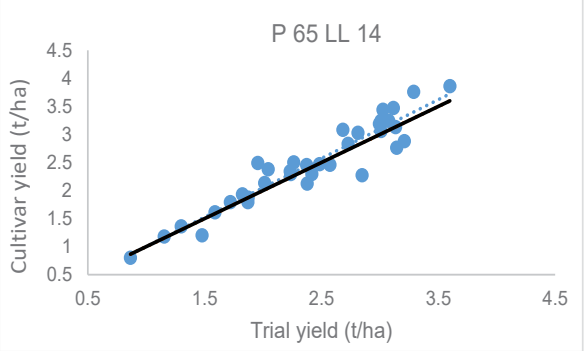


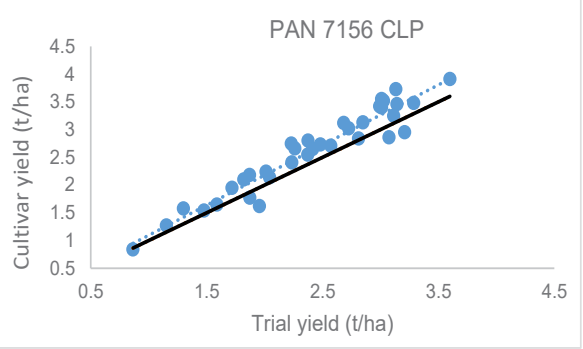

LG 5710
Cultivar yield (t/ha)
Trial yield (t/ha)

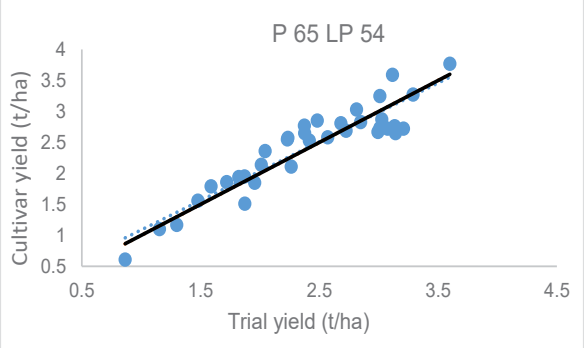

P 64 LL 23
Cultivar yield (t/ha)
Trial yield (t/ha)

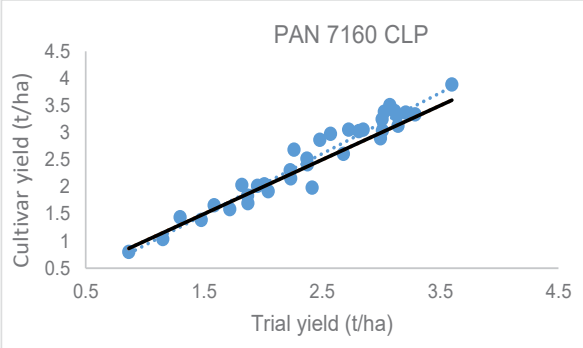

P 65 LL 02
Cultivar yield (t/ha)
Trial yield (t/ha)

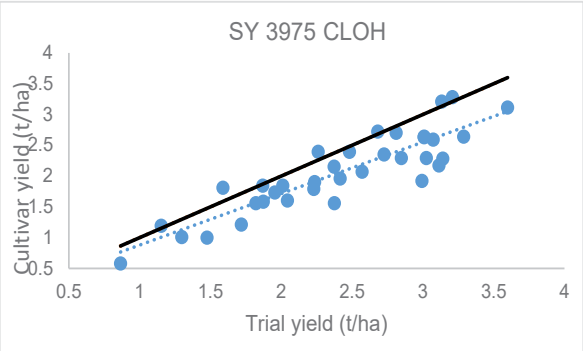

PAN 7100 CLP
Cultivar yield (t/ha)
Trial yield (t/ha)

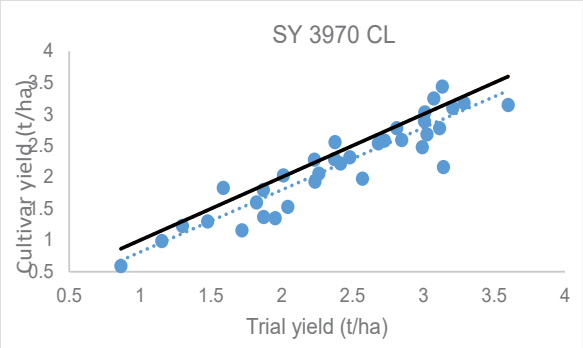

P 65 LL 14
Cultivar yield (t/ha)
Trial yield (t/ha)

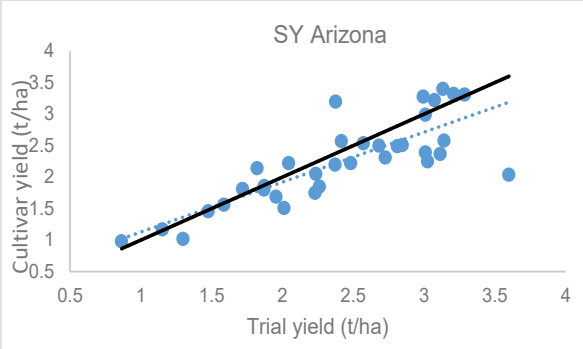

PAN 7156 CLP
Cultivar yield (t/ha)
Trial yield (t/ha)


P 65 LP 54
Cultivar yield (t/ha)
Trial yield (t/ha)


PAN 7160 CLP
Cultivar yield (t/ha)
Trial yield (t/ha)


SY 3975 CLOH
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1
1.5
2
2.5
3
3.5
4


SY 3970 CL
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1
1.5
2
2.5
3
3.5
4


SY Arizona
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1
1.5
2
2.5
3
3.5
4

DEPARTMENT OF AGRICULTURE, FORESTRY AND FISHERIES

NO. 45 **22 JANUARY 2016**

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

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

The Minister of Agriculture, Forestry and Fisheries under section 15 of the Agricultural Product Standards Act 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 thereof; and

(c) read together with section 3(1) of the said Act, repealed the Regulations published by Government Notice No. R 477 of 20 June 2014.

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;

"bag" means a bag manufactured from--

(a) jute or phormium or a mixture of jute and phormium; or

(b) polypropylene that compiles with SANS specification CKS632 1246: 2012;

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

"consignment" means--

(a) a quantity of sunflower seed of the same class, which belongs to the same owner, delivered at any one time under the same consignment note, delivery note or receipt note, or delivered by the same vehicle or bulk container, or loaded from the same bulk storage structure or from a ship's hold; or

(b) in the case where a quantity referred to in paragraph (a), is subdivided into a grade, each such quality of such grade.

"container" means a bag or a bulk container;

"damaged sunflower seed" means sunflower seed or portion thereof which is visibly discoloured as a result of external heat or heating due to internal fermentation;

"foreign matter" means--

(a) loose and empty shells above the sieve that occur in the consignment concerned; and

(b) all matter other than sunflower seed and the achene of sunflower seed above the standard sieve. Coal, dung, glass and metal shall not be present in the consignment at all.

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

"poisonous seeds" mean seeds or part of seeds of plant species that in terms of the Foodstuffs Cosmetics and Disinfectants Act 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;*

"sclerotia" means hard masses of fungal tissue produced by fungus *Sclerotinia sclerotiorum*. The sclerotia vary in size and form and consist of a dark black exterior, a white interior and a rough surface texture;

"screenings" means all material that passes through a standard sieve;

"standard sieve" means a slotted sieve--

(a) with a flat bottom of metal sheet of 1,0 mm thickness with apertures 12.7 mm long and 1.8 mm wide with rounded ends (±0.03 mm). 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 oriented with a slot always opposite the solid inter segment of the next row of slots;

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

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

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

"sunflower seed" means the seed of the plant species of *Helianthus annuus (L); and*

"the Act" means the Agricultural Product Standards Act 119 of 1990.

Restrictions on sale of sunflower seed

2. (1) No person shall sell sunflower seed in the Republic of South Africa--

(a) unless the sunflower seed are sold according to the classes set out in regulation 3;

(b) unless the sunflower seed comply with the standards for the classes concerned set out in regulation 4;

(c) unless the sunflower seed, where applicable, comply with the grades of sunflower seed and the standards for grades set out in regulation 5 and 6 respectively;

(d) unless the sunflower seed are packed in accordance with the packing requirements set out in regulation 7;

(e) unless the container 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 sunflower seed contains a substance that renders it unfit for human or animal 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): Provided that such exemption is done in terms of section 3(1) (c) of the Act.

PART I

QUALITY STANDARDS

Classes of sunflower seed

3. Sunflower seed shall be classified as--

(a) Class FH;

(b) Class FS; and

(c) Class Other Sunflower Seed.

Standards for classes of sunflower seed

4. (1) A consignment of sunflower seed shall --

(a) be free from a musty, sour, khaki bush or other undesired odour;

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

(c) not contain more poisonous seeds than permitted in terms of the Foodstuffs, Cosmetics and Disinfectants Act 54 of 1972;

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

(e) with the exception of Class Other Sunflower seed, be free from insects;

(f) with the exception of Class Other Sunflower seed, have a moisture content of not more than 10 percent; and

(g) be free from animal filth.

(2) A consignment of sunflower seed shall be classified as --

(a) Class FH if it--

(i) consist of at least 80 percent (m/m) sunflower seed of a cultivar with a high oil content; and

(ii) complies with the standard for Grade 1 set out in regulation 6.

(b) Class FS if it--

(i) consist of at least 80 percent (m/m) sunflower seed of a cultivar with a low oil content; and

(ii) complies with the standards for Grade 1 set out in regulation 6.

(c) Class Other Sunflower Seed if it does not comply with the requirements for Class FH or Class FS.

Grades for sunflower seed

5. (1) There is only one grade for the Classes FH and FS Sunflower Seed, namely Grade 1.

(2) No grades are determined for Class Other Sunflower seed.

Standards for grades of sunflower seed

6. A consignment of Grade 1 sunflower seed shall be graded as Grade 1 if the nature of deviation, specified in column 1 of Table 1 of the Annexure, in that consignment does not exceed the percentage specified in column 2 of the said table opposite the deviation concerned.

PART II

PACKING AND MARKING REQUIREMENTS

Packing requirements

7. Sunflower seed of different classes and grades shall be packed in different containers or stored separately.

Marking requirements

8. Every container or the accompanying sale documents of a sunflower seed shall be marked or endorsed with the class and, where applicable, the grade of the sunflower seed.

PART III

SAMPLING

Obtaining a sample

9. (1) A representative sample of a consignment of sunflower seed shall--

(a) in the case of sunflower seed delivered in bags and subject to regulation 10, be obtained by sampling at least 10 percent 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 sunflower seed 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 5 kg; and

(b) be thoroughly mixed by means of dividing 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) If it is suspected that the sample referred to in sub-regulation (1) (b) is not representative of that consignment, an additional representative sample shall be obtained by using an alternative sampling pattern, apparatus or method.

(5) 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 sunflower seed taken from different bags in a consignment in terms of regulation 9(1), it appears that the contents of those bags differ substantially--

(a) the bags concerned shall be separated from each other;

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

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

(2) If, after the discharge of a consignment of sunflower seed 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 that part of the consignment remaining in the bulk container, as well as the sunflower seed already in the collecting tray, shall be sampled anew with a bulk sampling apparatus or by catching at least 20 samples at regular intervals throughout the whole off loading period with a suitable container from the stream of sunflower seed that is flowing in bulk.

Working sample

11. (1) A working sample of sunflower seed shall be obtained by dividing the representative sample of the consignment according to the latest revision of the ICC (International Association for Science and Technology) 101/1 method.

PART IV

INSPECTION METHODS

Determination of undesired odour, harmful substances, poisonous seeds, stones, glass, metal, coal, dung, insect and animal filth

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

(a) has a musty, sour, khaki bush or other undesired odour;

(b) contains a substance that renders it unsuitable for human or animal consumption or processing into or utilization thereof as food or feed;

(c) contains poisonous seeds;

(d) contains stones, glass, metal, coal or dung;

(e) contains any insects; and

(f) contains animal filth.

Determination of moisture content

13. The moisture content of a consignment of sunflower seed may be determined according to any suitable method: Provided that the result thus obtained is in accordance with the maximum permissible deviation for a class 1 moisture meter as detailed in ISO 7700/2, based upon result of the 3 hour, 103°C oven dried method [the latest revision of the AACCI ("American Association of Cereal Chemists International") Method 44-15].

Determination of percentage screenings

14. The percentage screenings in a consignment of sunflower seed is determined as follows:

(a) Obtain a working sample of at least 50g from a representative sample of the consignment.

(b) Place the sample on a standard sieve; screen the sample by moving the sieve 50 strokes to and fro, alternately away from and towards the operator of the sieve, in the same direction as the long axes of the slots of the sieve. Move the sieve, which rests on a table or other suitable smooth surface, 250 mm to 460 mm away from and towards the operator with each stroke. The prescribed 50 strokes must be completed within 50 to 60 seconds: Provided that the screening process may also be performed in some or other container or an automatic sieving apparatus.

(c) Determine the mass of the material that has passed through the sieve and express it that as a percentage of the mass of the working sample.

(d) Such percentage represents the percentage screenings in the consignment.

Determination of percentage foreign matter

15. The percentage foreign matter in a consignment of sunflower seed shall be determined as follows:

(a) Obtain a working sample of at least 20g of a screened sample.

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

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

(d) Such a percentage represents the percentage foreign matter in the consignment.

Determination of percentage sclerotia

16. The percentage sclerotia in a consignment of sunflower seed is determined as follows:

(a) Remove all sclerotia in the working sample in 15(a) obtained by hand and determine the mass thereof.

(b) Express the mass thus determined as a percentage of the working sample in regulation 15(a) obtained.

(c) Such a percentage represents the percentage sclerotia in the consignment.

Determination of percentage sunflower seed of another class

17. The percentage sunflower seed of another class in a consignment of sunflower seed shall be determined as follows:

(a) Obtain a working sample of at least 20g from a screened sample free of foreign matter and sclerotia.

(b) Remove all sunflower seeds of another class from the working sample by hand and determine the mass thereof.

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

(d) Such a percentage represents the percentage sunflower seed of another class in the consignment.

Determination of the percentage damaged sunflower seed

18. The percentage damaged sunflower seed in a consignment of sunflower seed, shall be determined as follows:

(a) Obtain a working sample of at least 20 g from a screened sample free of foreign matter and sclerotia.

(b) Shell the seed in the working sample by hand or with a machine so that nucleus portions thereof are retained.

(c) Remove all damaged sunflower seed from the quantity thus shelled and determine the mass thereof.

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

(e) Such a percentage represents the percentage damaged sunflower seed in the consignment.

PART V

MASS DETERMINATION

19. The mass of sunflower seed shall be determined by deducting the actual percentage sclerotia, screenings and foreign matter found during the inspection process from the total mass of the consignment: Provided that the weighing instruments used for the determination of mass shall comply with the requirements of SANS 1649:2001 published in terms of the Trade Metrology Act 77 of 1973 for the specific class of instrument.

PART VI

OFFENCE 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

TABLE 1

STANDARDS FOR GRADES OF SUNFLOWER SEED

DEVIATIONS		**Maximum permissible deviations**	
		Class FH	**Class FS**
		Grade1	
1.	Damaged sunflower seed	10%	
2.	Screenings	4%	
3.	Sclerotia	4%	
4.	Foreign Matter	4%	
5.	Deviation in 2,3 and 4 collectively: Provided that such deviations are individually within the limits of said items.	6%