Report

Evaluation of sunflower cultivars:
2017/2018 season

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

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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 2017/2018 season with the voluntary collaboration of Agricol, Pannar, Pioneer, Syngenta and AGT. Seed companies entered 19 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.

Eight of the 19 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®. One hybrid (PAN 7158 HO) of the 19 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 8 trials, Pannar with 6, Pioneer with 4 and Syngenta with 1. 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.

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Ten trials of Pannar and Pioneer were not planted due to technical issues within the company, two trials were not successful due to late planting and sclerotinia, bird damage, replanting not harvested or even not planted. 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 five trials at Potchefstroom and two trials at Boskop and one trial at Ventersdorp, Rysmierbult ,Lichtenburg, Viljoenskroon, and Senekal,

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 12 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 12 trials.

Yield probabilities were also calculated for 12 cultivars that were evaluated in 25 trials during 2016/2017 and 2017/2018.

RESULTS

Days from planting to flowering

The mean number of days from planting to 50% flowering of cultivars (Table 4) ranged from 68 (PAN 7102 CLP, PHB 65A70 and AGSUN 5270) to 72 days (AGSUN 5103 CLP, P 65 LL 02, PAN 7158 HO , AGSUN 5106 CLP and SY 3970 CL). Calculated across cultivars and planting dates, the period from planting to flowering was 70 days.

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 38.84 to 49.44% with an overall mean of 41.58%.

The highest mean oil concentration among localities was at Potchefstroom (planting date 20 October 2017) with 47.32%. The locality with the lowest mean oil content of 33.28% was Senekal planting date was January 28, 2018. The highest oil concentration among

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cultivars and calculated across localities, was SY 3970 CL at 49.44% followed by P 65 LL 02 at 44.99%

The average protein content varied from 16.73 to 19.8% among cultivars at the different localities. Among localities, Potchefstroom planted in January 24, 2018 had the highest and Potchefstroom planted in October 20, 2017 the lowest protein content of 24.05 and 15.84% respectively. Calculated across localities, AGSUN 5101 CLP had the highest protein content (19.80 %) followed by AGSUN 5103 CLP and AGSUN 8251(19.5) while PAN 7156 CLP the lowest (16.63%).

Seed yield

The mean seed yield of cultivars at the respective localities is presented in Table 7. The highest locality mean yield of 3.39 t ha^{-1} was obtained at Boskop2 planted on 12 December 2017 and the lowest of 1.32 t ha^{-1}, at Senekal planted on 28th January 2018.

The five best performing cultivars, in terms of average yield calculated over localities, were PAN 7160 CLP, P 65 LL02, PAN 7100, AGSUN 5272 and PAN 7156 CLP. The overall mean yield for 2017/18 was 2.38 t ha^{-1}, 6 % higher than the mean yield of 2016/17.

One high oleic cultivar (PAN 7158 HO) was entered for evaluation in 2017/2018. Eight Clearfield and Clearfield Plus cultivars, AGSUN 5101 CLP, AGSUN 5102 CLP, AGSUN 5103 CLP, AGSUN 5106 CLP, PAN 7102 CLP, PAN 7156 CLP, PAN 7160 CLP and SY 3970 CL were entered. Five of these cultivars namely, PAN 7160 CLP, PAN 7156 CLP, AGSUN 5103 CLP, AGSUN 5106 CLP and PAN 7102 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 seven localities varied from 0.90 to 1.11 t ha-1 with an overall mean of 1.0 t ha-1. The locality with the highest mean oil yield was Boskop planted in December 12, 2017 at 1.53 t ha-1. P 65 LL 02 has the highest oil yield of 1.11 t ha-1 followed by PAN 7160 CLP with 1.10 t ha-1

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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 (D-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 2017/18 are shown in Figure 1 and for the 13 cultivars evaluated in 2016/17 and 2017/18 in Figure 2.

The yield stability of cultivars varied up to 21 fold among cultivars (Table 10). Cultivars which had exceptionally high stabilities (D-parameter ≤ 0.05) were, AGSUN 5102 CLP , PAN 70160 CLP, PAN 7100, AGSUN 5278, AGSUN 5273, AGSUN 5101 CLP, P 65LP 54, P 65 LL02, PAN 7102 CLP, AGSUN 5103 CLP, PAN 7102 CLP, AGSUN 5103 CLP and PAN 7080

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 19 cultivars for 2017/18 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 13 cultivars evaluated in 24 trials in 2016/17 and 2017/18, are shown in Table 12. Tables 11 and 12 should be used jointly for cultivar selection.

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Acknowledgements

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 and seed germination rate and supplier company 2017/18

Cultivar's Name	Germinated (%)			Company
	Normal	Abnormal	Dormant/dead	
AGSUN 5101 CLP	100	0	0	Agricol
AGSUN 5102 CLP	96	1	3	
AGSUN 5103 CLP	98	1	1	
AGSUN 5106 CLP	98	1	1	
AGSUN 5270	97	1	2	
AGSUN 5273	100	0	0	
AGSUN 5278	98	0	2	
AGSUN 8251	95	0	5	
PAN 70160 CLP	99	0	1	Pannar
PAN 7080	99	1	0	
PAN 7100	98	2	0	
PAN 7102 CLP	98	1	1	
PAN 7156 CLP	97	3	0	
PAN 7158 HO	97	3	0	
P 65 LL 02	97	1	2	Pioneer
P 65 LL14	94	2	4	
P 65 LP 54	98	1	1	
PHB 65A70	95	4	1	
SY 3970 CL	97	2	1	Syngenta

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Table 2: Collaborating company, trial localities and responsible co-workers 2017/18

Company	Localities	Planting dates	Co-workers	E-mail address of co-worker
Agricol	Boskop 1 Boskop 2 Ventersdorp Lichtenburg Rysmierbult Vilioenskroon	07/11/2017 12/12/2007 30/01/2018 01/12/2017 01/12/2017 02/01/2018	J Swanepoel	Jouberts@agricol.co.za
ARC-GCI	Potchefstroom	20/10/2017 08/11/2017 20/11/2017 04/12/2017 24/01/2018	W Makgoga & J Erasmus	Makgogamw@arc.agric.za Erasmusi@arc.agric.za
PANNAR			A Pretorius	abre.pretorius@pannar.co.za
Pioneer			P Fourie	philip.fourie@pioneer.com]
Syngenta	Senekal	28/01/2018	Roean Wessels & Janin wessels	roean.wessels@sensako.co.za janinewessels@yahoo.com

Table 3:Trial site information 2017/18

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	Nett plot size (m²)
				pH (KCl)	P	K	Ca	Mg				
Vilioenskroon	02/01/2018	42 000	Red Clay	-	-	-	-	-	300 kg 5.3.1	91	Plough & disc	7.28
Ventersdorp	30/01/2018	42 000	-	-	-	-	-	-	25 N, 8 P, 4 K	-	Cruiser, Metolachlor, Boron	12.7
Boskop	07/11/2017	45000	-	-	-	-	-	-	-	91	-	11.83
Boskop	12/12/2017	45000	-	-	-	-	-	-	-	91	-	11.83
Lichtenburg	01/12/2017	42000	-	-	-	-	-	-	-	91	-	6.82
Rysmierbult	01/12/2017	45000	-	-	-	-	-	-	-	91	-	7.28
Potchefstroom	20/10/2017	38 000	Westleigh	6.43	52	278	958	488	N 41; P 9; K 4	90	Grammoxone	11.83
Potchefstroom	08/11/2017	38 000	Clovelly	6.22	46	370	925	533	N 41; P 9; K 4	90	Grammoxone	14.4
Potchefstroom	20/11/2017	38 000	Westleigh	6.22	46	370	925	533	N 41; P 9; K 4	90	Grammoxone	14.4
Potchefstroom	04/12/2017	38 000	Clovelly	6.22	46	370	925	533	N 41; P 9; K 4	90	Grammoxone	14.4
Potchefstroom	24/01/2018	38 000	Clovelly	-	-	-	-	-	N 41; P 9; K 4	90		14.4
Senekal	28/01/2018											7.28

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Table 4: Number of days from planting to 50 percent flowering of cultivars at selected localities and planting dates 2017/2018

Cultivar	Boskop 07/11/2017	Boskop 12/12/2017	Lichtenburg 01/12/2017	Rysmierbult 01/12/2017	Viljoenskroon 02/01/2018	Ventersdorp 30/01/2018	Senekal 28/01/2018	Potchefstroom 20/10/2017	Potchefstroom 08/11/2017	Potchefstroom 20/11/2017	Potchefstroom 04/12/2017	Potchefstroom 04/12/2017	Mean
AGSUN 5101 CLP	70	61	70	66	70	73	80	81	69	67	66	75	71
AGSUN 5102 CLP	72	61	69	66	69	72	81	81	69	65	63	76	70
AGSUN 5103 CLP	73	63	71	67	71	77	78	80	72	68	65	75	72
AGSUN 5106 CLP	72	62	71	69	71	78	79	81	71	67	66	77	72
AGSUN 5270	70	58	67	65	67	77	76	75	71	65	63	70	69
AGSUN 5273	73	63	70	68	70	79	78	77	71	68	65	72	71
AGSUN 5278	72	61	69	66	69	73	77	81	68	65	63	73	70
AGSUN 8251	70	61	69	66	69	75	78	80	71	66	63	72	70
P 65 LL 02	73	62	71	70	71	71	79	81	73	70	68	72	72
P 65 LL14	70	61	67	71	67	73	77	77	69	65	65	73	70
P 65 LP 54	69	58	67	67	67	73	78	75	69	65	63	73	69
PAN 7160 CLP	68	60	70	70	70	74	79	76	70	66	65	72	70
PAN 7080	69	61	70	69	70	71	77	76	70	66	64	75	70
PAN 7100	70	60	69	67	69	68	76	75	68	66	62	71	68
PAN 7102 CLP	68	58	67	64	67	72	78	74	68	64	62	72	68
PAN 7156 CLP	69	60	70	70	70	76	81	78	69	66	63	76	71
PAN 7158 HO	73	64	69	67	69	77	79	82	71	68	66	78	72
PHB 65A70	68	58	71	63	71	68	77	75	68	66	63	72	68
SY 3970 CL	73	62	71	69	71	73	80	81	71	68	68	73	72
Mean	71	61	69	67	69	74	78	78	70	66	64	74	

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Table 5: The moisture free seed oil concentration (%) of cultivars at selected localities 2017/2018

Cultivar	Boskop 12/12/2017	Ventersdorp 30/01/2018	Viljoenskroon 02/01/2018	Senekal 28/01/2018	Potchefstroom 20/10/2017	Potchefstroom 04/12/2017	Potchefstroom 24/01/2018	Mean
AGSUN 5102 CLP	44.87	34.39	43.19	32.45	44.35	45.61	35.76	40.09
AGSUN 5102 CLP	45.64	34.64	43.49	29.45	45.10	44.01	38.45	40.11
AGSUN 5103 CLP	43.73	36.85	43.31	30.72	44.07	45.70	36.23	40.09
AGSUN 5106 CLP	43.55	36.59	42.35	30.70	46.00	46.02	35.48	40.10
AGSUN 5270	43.40	42.50	45.63	38.97	49.53	46.63	37.55	43.46
AGSUN 5273	44.40	35.33	42.68	32.68	46.23	44.64	35.28	40.18
AGSUN 5278	42.39	34.23	41.97	32.11	44.67	43.85	34.29	39.07
AGSUN 8251	41.60	34.04	43.13	33.42	44.60	43.98	34.69	39.35
P 65 LL 02	48.67	43.96	45.33	37.11	49.37	50.65	39.85	44.99
P 65 LL14	47.74	42.36	45.45	35.83	49.82	48.27	39.45	44.13
P 65 LP 54	40.57	34.71	40.61	31.67	45.38	44.85	34.08	38.84
PAN 7160 CLP	46.23	33.56	45.40	33.46	49.29	48.09	37.10	41.88
PAN 7080	44.78	34.76	45.79	29.54	48.87	46.51	38.12	41.20
PAN 7100	47.15	37.78	44.51	35.41	49.21	48.02	36.21	42.61
PAN 7102 CLP	45.42	38.89	41.08	32.29	46.40	43.61	33.32	40.14
PAN 7156 CLP	44.98	37.35	41.50	29.19	47.62	43.55	35.66	39.98
PAN 7158 HO	43.58	39.68	42.56	30.64	45.03	44.18	40.53	40.88
PHB 65A70	45.35	41.99	44.12	37.94	47.67	47.48	40.34	43.55
SY 3970 CL	53.36	45.94	51.31	38.78	55.94	53.94	46.85	49.44
Mean	45.13	37.87	43.86	33.28	47.32	46.29	37.33	41.58

Table 6: The moisture free seed protein concentration (%) of cultivars at selected localities 2017/2018

Cultivar	Boskop 12/12/2017	Ventersdorp 30/01/2018	Viljoenskroon 02/01/2018	Senekal 28/01/2018	Potchefstroom 20/10/2017	Potchefstroom 04/12/2017	Potchefstroom 24/01/2018	Mean
AGSUN 5102 CLP	20.51	25.14	18.28	15.91	16.91	17.36	24.53	19.80
AGSUN 5102 CLP	19.44	23.91	19.28	15.95	16.17	17.63	22.44	19.26
AGSUN 5103 CLP	21.35	22.75	18.10	15.51	16.87	16.93	25.04	19.51
AGSUN 5106 CLP	20.63	22.34	17.76	16.71	15.21	16.21	25.01	19.13
AGSUN 5270	20.19	17.60	15.81	15.37	17.62	18.77	24.88	18.61
AGSUN 5273	19.50	22.23	16.79	15.97	16.66	18.34	25.05	19.22
AGSUN 5278	20.56	23.92	16.15	16.52	17.01	17.22	24.06	19.35
AGSUN 8251	20.27	24.74	17.49	16.11	15.67	16.87	25.04	19.45
P 65 LL 02	18.90	16.32	16.50	16.31	15.05	16.50	24.39	17.71
P 65 LL14	18.32	16.68	17.09	15.59	16.21	16.79	22.87	17.65
P 65 LP 54	21.52	24.08	18.11	17.24	14.75	16.30	24.07	19.44
PAN 7160 CLP	19.06	23.06	15.99	14.35	15.89	16.89	23.67	18.41
PAN 7080	19.23	23.16	15.92	15.87	13.19	15.35	22.98	17.96
PAN 7100	18.91	21.70	17.58	14.73	15.61	16.81	24.00	18.48
PAN 7102 CLP	19.36	16.34	18.85	17.54	16.96	16.86	24.49	18.63
PAN 7156 CLP	18.19	13.48	18.14	13.49	14.66	16.42	22.75	16.73
PAN 7158 HO	20.01	16.35	16.92	16.02	15.73	16.92	24.24	18.03
PHB 65A70	19.81	17.10	16.93	15.85	15.77	15.77	22.42	17.66
SY 3970 CL	19.11	22.88	16.06	17.28	14.97	17.29	25.00	18.94
Mean	19.73	20.73	17.25	15.91	16.91	16.91	24.05	18.63

Table 7: Mean seed yield (t ha⁻¹) of cultivars at each locality 2017/2018

Cultivar	Boskop 07/11/2017	Boskop 12/12/2017	Lichtenburg 01/12/2017	Rysmierbult 01/12/2017	Viljoenskroon 02/01/2018	Potchefstroom 20/10/2017	Potchefstroom 08/11/2017	Potchefstroom 20/11/2017	Potchefstroom 04/12/2017	Potchefstroom 24/01/2018	Senekal 28/01/2018	Ventersdorp 30/01/2018	Mean
AGSUN 5101 CLP	2.72	3.59	1.80	1.94	3.14	2.52	2.12	2.36	2.67	1.39	1.03	1.38	2.22
AGSUN 5102 CLP	2.95	3.31	1.88	2.15	2.78	2.42	2.19	2.51	2.69	1.30	1.24	1.18	2.22
AGSUN 5103 CLP	3.42	3.69	2.24	2.47	3.35	2.46	2.28	2.52	3.04	1.11	1.23	1.49	2.44
AGSUN 5106 CLP	3.33	3.35	2.06	2.78	3.26	2.26	2.28	2.53	2.93	1.33	1.45	1.69	2.44
AGSUN 5270	3.13	3.45	2.14	2.35	3.41	2.45	2.52	2.72	2.82	1.70	1.57	1.22	2.46
AGSUN 5273	2.88	3.23	2.19	2.25	3.16	2.32	2.30	2.35	2.55	1.52	1.36	1.33	2.29
AGSUN 5278	2.77	2.98	2.11	2.09	2.90	2.30	2.53	2.22	3.02	1.46	1.49	1.41	2.27
AGSUN 8251	3.31	3.47	2.34	2.51	3.25	2.20	2.15	2.08	2.71	1.56	1.39	1.45	2.37
P 65 LL 02	2.80	3.47	2.26	2.45	3.05	2.89	2.88	3.02	3.06	1.39	1.31	1.51	2.51
P 65 LL14	3.20	3.15	1.59	1.89	3.19	2.65	2.46	3.01	2.99	1.46	1.55	1.63	2.40
P 65 LP 54	2.92	3.67	1.96	1.97	2.81	2.66	2.69	2.78	3.07	1.46	1.16	1.34	2.37
PAN 7160 CLP	3.35	3.65	2.16	2.40	3.32	2.73	2.65	2.73	3.07	1.47	1.51	1.82	2.57
PAN 7080	2.99	3.53	2.20	2.06	3.34	2.73	2.23	2.93	3.29	1.54	0.94	1.31	2.42
PAN 7100	3.27	3.40	1.92	2.64	3.48	2.66	2.69	2.73	3.07	1.52	1.28	1.41	2.51
PAN 7102 CLP	3.05	3.46	2.30	2.05	2.90	2.60	2.75	2.85	2.93	1.63	1.51	1.11	2.43
PAN 7156 CLP	2.68	3.80	1.74	2.75	2.78	2.52	2.6	2.71	3.17	1.85	1.25	1.62	2.46
PAN 7158 HO	2.54	3.19	2.09	2.68	2.99	2.63	2.6	2.56	2.92	1.29	1.16	1.36	2.33
PHB 65A70	2.95	3.13	1.89	2.15	2.34	2.77	2.82	2.9	3.27	1.82	1.36	1.56	2.41
SY 3970 CL	2.59	2.97	1.52	1.84	2.62	2.38	2.57	2.51	2.71	1.32	1.35	1.15	2.13
Mean	2.99	3.39	2.02	2.28	3.06	2.54	2.49	2.63	2.95	1.48	1.32	1.42	2.38
CV	10.30	8.70	13.60	11.30	9.50	8.60	11.40	7.70	8.10	14.50	19.60	17.40	

Table 8: Oil yield (t ha⁻¹) of cultivars at selected localities 2017/18

Cultivar	Boskop 12/12/2017	Ventersdorp 30/01/2018	Viljoenskroon 02/01/2018	Senekal 28/01/2018	Potchefstroom 20/10/2017	Potchefstroom 04/12/2017	Potchefstroom 24/01/2018	Mean
AGSUN 5102 CLP	1.61	0.47	1.36	0.33	1.12	1.22	0.50	0.94
AGSUN 5102 CLP	1.51	0.41	1.21	0.37	1.09	1.18	0.55	0.90
AGSUN 5103 CLP	1.61	0.55	1.45	0.38	1.08	1.39	0.40	0.98
AGSUN 5106 CLP	1.46	0.62	1.38	0.45	1.04	1.35	0.47	0.97
AGSUN 5270	1.50	0.52	1.56	0.61	1.21	1.31	0.64	1.05
AGSUN 5273	1.43	0.47	1.35	0.44	1.07	1.14	0.54	0.92
AGSUN 5278	1.26	0.48	1.22	0.48	1.03	1.32	0.50	0.90
AGSUN 8251	1.44	0.49	1.40	0.46	0.98	1.19	0.54	0.93
P 65 LL 02	1.69	0.66	1.38	0.49	1.43	1.55	0.55	1.11
P 65 LL14	1.50	0.69	1.45	0.56	1.32	1.44	0.58	1.08
P 65 LP 54	1.49	0.47	1.14	0.37	1.21	1.38	0.50	0.93
PAN 7160 CLP	1.69	0.61	1.51	0.51	1.35	1.48	0.55	1.10
PAN 7080	1.58	0.46	1.53	0.28	1.33	1.53	0.59	1.04
PAN 7100	1.60	0.53	1.55	0.45	1.31	1.47	0.55	1.07
PAN 7102 CLP	1.57	0.43	1.19	0.49	1.21	1.28	0.54	0.96
PAN 7156 CLP	1.71	0.61	1.15	0.36	1.20	1.38	0.66	1.01
PAN 7158 HO	1.39	0.54	1.27	0.36	1.18	1.29	0.52	0.94
PHB 65A70	1.42	0.66	1.03	0.52	1.32	1.55	0.73	1.03
SY 3970 CL	1.58	0.53	1.34	0.52	1.33	1.46	0.62	1.06
Mean	1.53	0.54	1.34	0.44	1.20	1.37	0.55	1.00

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

Locality	Mean (t ha⁻¹)	SE	CV (%)	GCV	t	SE(t)	tn
Boskop 07/11/2017	2.99	0.18	10.30	6.80	0.30	0.15	0.56
Lichtenburg 01/12/2017	2.02	0.16	13.60	8.70	0.29	0.15	0.55
Rysmierbult 01/12/2017	2.28	0.15	11.30	11.40	0.50	0.14	0.75
BOSKOP2 12/12/2017	3.39	0.17	8.70	4.90	0.24	0.15	0.49
Vilionskroon 02/01/2018	3.06	0.17	9.50	8.10	0.42	0.15	0.68
Ventersdorp 30/01/2018	1.42	0.14	17.40	8.80	0.20	0.15	0.43
Senekal 28/01/2018	1.32	0.15	19.60	6.60	0.10	0.15	0.25
Potchefstroom 20/10/2017	2.54	0.13	8.60	5.80	0.31	0.15	0.57
Potchefstroom 08/11/2017	2.49	0.16	11.40	6.80	0.26	0.15	0.51
Potchefstroom 20/11/2017	2.63	0.12	7.70	9.00	0.58	0.12	0.81
Potchefstroom 04/12/2017	2.95	0.14	8.10	5.30	0.30	0.15	0.56
Potchefstroom 24/01/2008	1.48	0.12	14.50	9.10	0.28	0.15	0.54

Table 10: Regression line coordinates at different yield potentials 2017/18

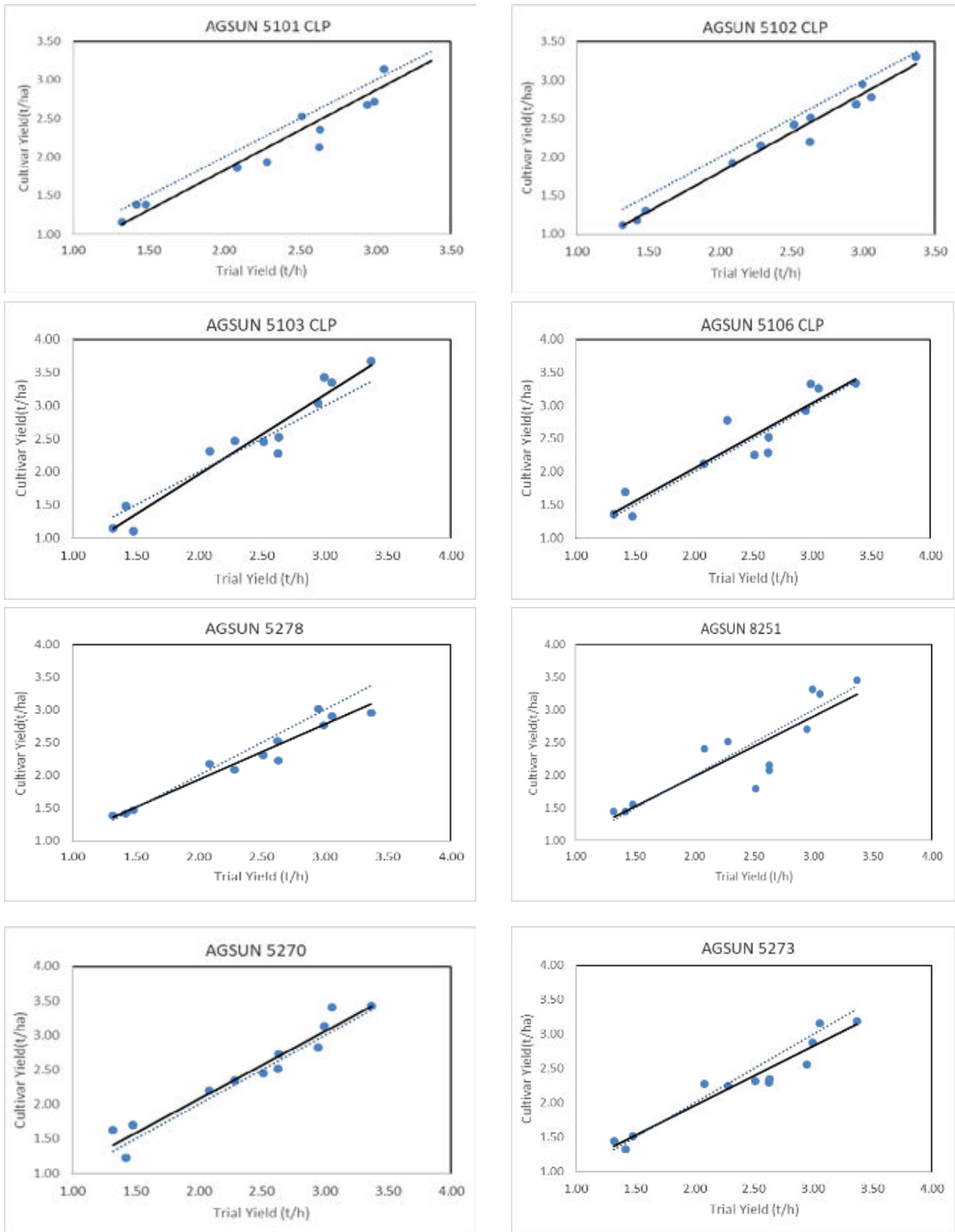| Cultivar	Yield potential (t ha⁻¹)						Mean (t ha⁻¹)	Intercept	Slope	D-parameter
	1	1.5	2	2.5	3	3.5				
AGSUN 5101 CLP	0.75	1.29	1.82	2.36	2.89	3.43	2.22	-0.32	1.07	0.034
AGSUN 5102 CLP	0.83	1.33	1.83	2.33	2.83	3.33	2.22	-0.17	1.00	0.008
AGSUN 5103 CLP	0.79	1.39	1.98	2.58	3.17	3.77	2.44	-0.40	1.19	0.042
AGSUN 5106 CLP	1.09	1.58	2.07	2.56	3.05	3.54	2.44	0.11	0.98	0.061
AGSUN 5270	1.07	1.57	2.07	2.57	3.07	3.57	2.46	0.07	1.00	0.028
AGSUN 5273	1.05	1.50	1.94	2.39	2.83	3.28	2.29	0.16	0.89	0.024
AGSUN 5278	1.14	1.56	1.97	2.39	2.80	3.22	2.27	0.31	0.83	0.025
AGSUN 8251	1.06	1.54	2.01	2.49	2.96	3.44	2.37	0.11	0.95	0.088
P 65 LL 02	1.09	1.60	2.11	2.62	3.13	3.64	2.51	0.07	1.02	0.039
P 65 LL14	1.05	1.54	2.03	2.52	3.01	3.50	2.40	0.07	0.98	0.071
P 65 LP 54	0.85	1.40	1.95	2.50	3.05	3.60	2.37	-0.25	1.10	0.032
PAN 7160 CLP	1.15	1.67	2.18	2.70	3.21	3.73	2.57	0.12	1.03	0.014
PAN 7080	0.78	1.38	1.97	2.57	3.16	3.76	2.42	-0.41	1.19	0.044
PAN 7100	0.97	1.53	2.09	2.65	3.21	3.77	2.51	-0.15	1.12	0.022
PAN 7102 CLP	1.05	1.55	2.04	2.54	3.03	3.53	2.43	0.06	0.99	0.041
PAN 7156 CLP	1.13	1.61	2.09	2.57	3.05	3.53	2.46	0.17	0.96	0.081
PAN 7158 HO	1.00	1.48	1.96	2.44	2.92	3.40	2.33	0.04	0.96	0.047
PHB 65A70	1.26	1.68	2.09	2.51	2.92	3.34	2.41	0.43	0.83	0.094
SY 3970 CL	0.90	1.35	1.80	2.25	2.70	3.15	2.13	0.00	0.90	0.035

Table 11: Yield probability (%) of cultivars for 2017/18 at different yield potentials

Cultivar	Yield potential (t ha⁻¹)						
	1	1.5	2	2.5	3	3.5
AGSUN 5101 CLP	13	15	18	23	29	37
AGSUN 5102 CLP	6	4	4	3	4	5
AGSUN 5103 CLP	20	31	46	65	78	87
AGSUN 5106 CLP	62	61	61	59	57	56
AGSUN 5270	64	65	65	66	65	64
AGSUN 5273	61	50	36	25	15	11
AGSUN 5278	77	63	43	25	12	6
AGSUN 8251	57	55	51	49	45	43
P 65 LL 02	65	68	70	72	73	73
P 65 LL14	56	55	54	53	51	50
P 65 LP 54	24	31	40	50	60	69
PAN 7160 CLP	85	90	93	95	95	95
PAN 7080	19	30	45	63	76	86
PAN 7100	43	57	72	83	91	94
PAN 7102 CLP	58	59	57	58	55	55
PAN 7156 CLP	65	64	62	59	56	54
PAN 7158 HO	50	47	43	40	37	34
PHB 65A70	76	70	61	51	40	32
SY 3970 CL	33	24	15	10	7	5

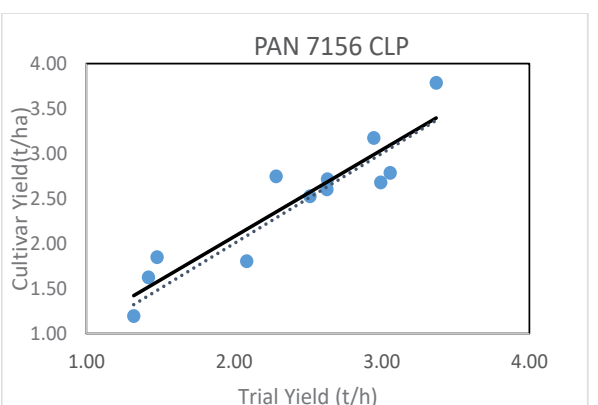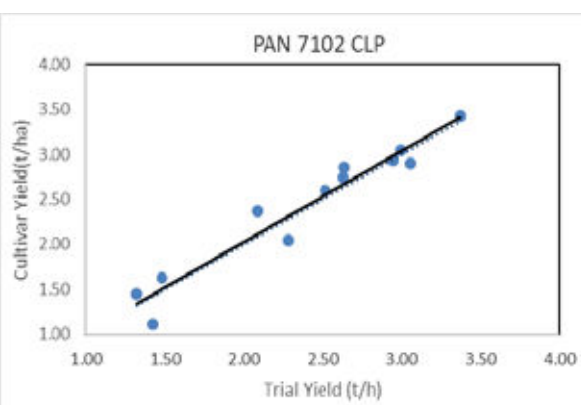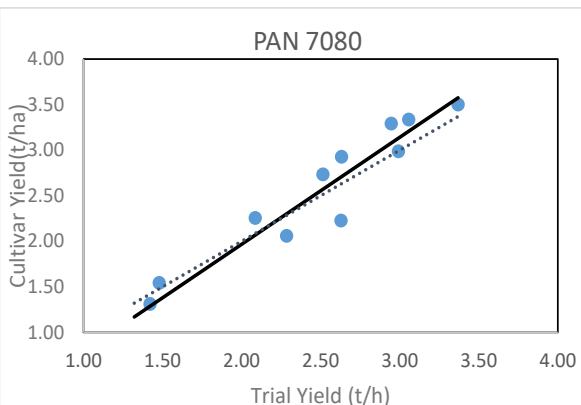**Table 12:** Yield probability (%) of cultivars 2016/2017 and 2017/2018 at different yield potentials

Cultivar	Yield potential (t ha^{-1})					
	1	1.5	2	2.5	3	3.5
AGSUN 5270	51	53	53	55	55	56
AGSUN 5273	31	35	38	44	48	54
AGSUN 5278	72	59	44	29	17	10
AGSUN 8251	62	58	54	49	44	40
P 65 LL02	52	53	54	55	55	57
P 65 LL14	34	37	40	44	47	51
P 65 LP54	64	57	48	40	32	25
PAN 7080	17	27	40	56	70	82
PAN 7100	41	50	60	70	78	84
PAN 7102 CLP	31	40	50	62	71	79
PAN 7156 CLP	71	68	62	57	50	45
PAN 7160 CLP	78	80	83	85	86	86
PHB 65A70	55	47	39	30	23	18

Table 13: Yield probability (%) of cultivars for three years data 2015/16 to 2017/2018 at different yield potentials

Cultivar	Yield potential (t ha^{-1})					
	1	1.5	2	2.5	3	3.5
AGSUN5270	46	48	50	52	54	55
AGSUN5273	28	33	36	41	45	50
AGSUN5278	58	49	39	29	21	15
AGSUN8251	57	54	51	49	46	43
P65LL02	59	60	58	58	56	56
P65LL14	50	50	48	48	47	47
PAN7080	37	45	53	63	70	77
PAN7100	48	53	59	64	68	72
PAN7102CLP	43	50	56	64	69	75
PAN7160CLP	67	71	73	76	78	80
PHB65A70	54	48	40	34	27	23

Figure 1: Regression lines for cultivars 2017/2018

P 65 LL 02

P 65 LL14

P 65 LP 54

PAN 70160 CLP

PAN 7080
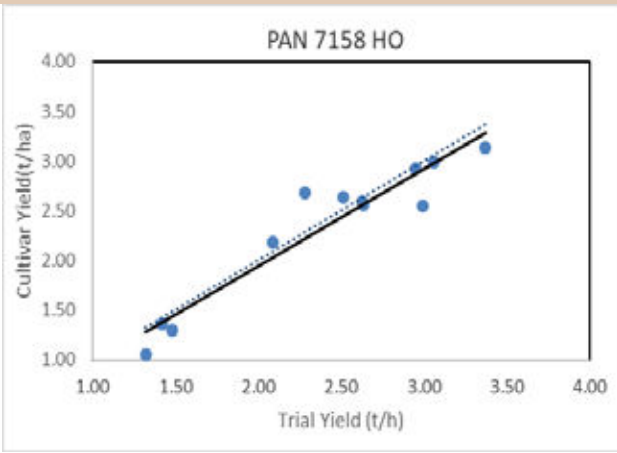

PAN 7100

PAN 7102 CLP

PAN 7156 CLP
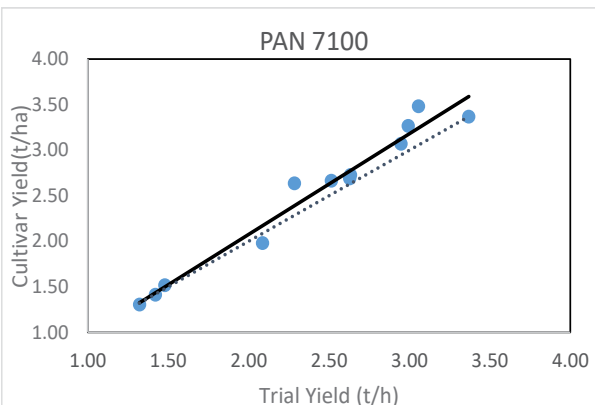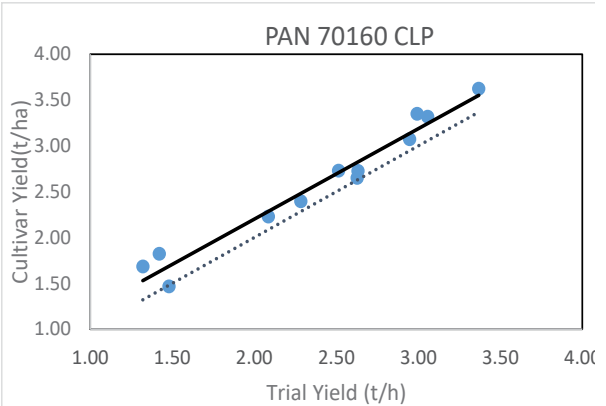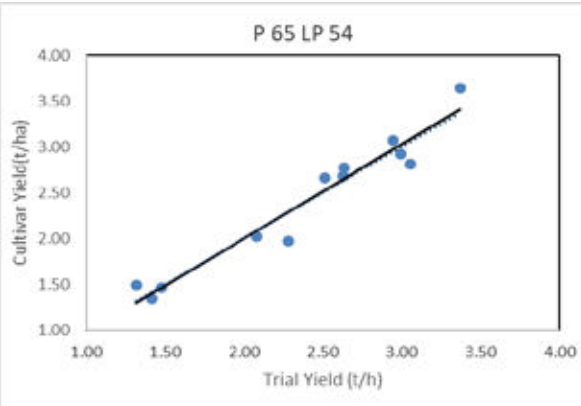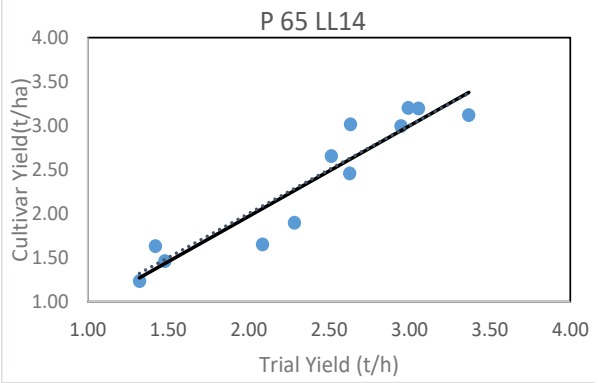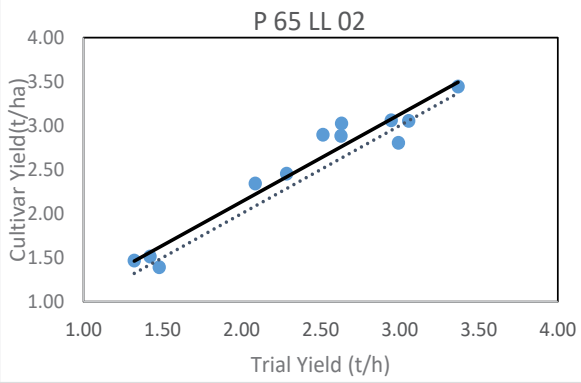
Figure 2 Regression lines for cultivars 2016/2017 and 2017/2018

P 65 LL 02

P 65 LL14

P 65 LP 54

PAN 7080

PAN 7100

PAN 7102 CLP

PAN 7156 CLP

PHB 65A70