Report

Evaluation of commercially available sunflower cultivars (M101/101-100407) 2015/2016 season

ARC–Grain Crops Institute in collaboration with the following seed companies: Agricol, Pannar, 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 2015/2016 season with the voluntary collaboration of Agricol, Pannar, Pioneer and Syngenta. Seed companies entered 21 cultivars for evaluation (Table 1) and supplied seed to the ARC-GCI 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). With the exception of one cultivar (P 65LC54), 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.

Six of the 21 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®.

Each collaborating seed company had to conduct at least one trial for each cultivar entry. Agricol was supplied with seed for nine trials, Pannar with 11, Pioneer with five and Syngenta with four. Five trials were planted by the ARC-GCI. Trial sites were selected by collaborators and the co-workers involved are listed in Table 2.

Due to extreme drought some trials could not be planted as intended, while others failed after planting. Planting dates, amount of fertiliser applied, soil analyses and other agronomic details from some successfull 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 three trials at Potchefstroom.

Yield data and seed samples were send by collaborators to ARC-GCI for analyses. Seed from selected trials were sent to SAGL for oil and protein content analyses. Yield data from 17 field trials were subjected to analyses of variance. Results from six trials were rejected due to coefficients of variation exceeding the 20% limit. 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 remaining 11 trials.

Yield probabilities were also calculated for 14 cultivars that were evaluated in 32 trials during 2014/2015 and 2015/2016.

RESULTS

Days from planting to flowering

The mean number of days from planting to 50% flowering of cultivars (Table 4) ranged from 56 (SY 4045, planting date 11 January 2016) to 70 days (P 65LL02, planting date 11 November 2015). Calculated across cultivars and planting dates, the period from planting to flowering was 65 days. Among cultivars, SY 4045 had the shortest period of 60 days and P 65LL02 the longest period from planting to flowering at 68 days.

Oil and protein concentration

The moisture free oil and protein concentrations of seed from eight 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 oil content for cultivars at the various localities varied from 33 to 54% with an overall mean of 41%. Adjusted for a moisture content of 9% at which sunflower grain is traded, the overall mean would be about 37%.

The highest mean oil concentration among localities was at Potchefstroom (planting date 11 January 2016) with 46%. The locality with the lowest mean oil content of 37% was Delmas. The highest oil concentration among cultivars and calculated across localities, was SY 3970 CL at 46%.

The protein content varied from 14 to 25% among cultivars at the different localities.

Among localities, Boskop had the highest and Reitz the lowest protein content of 22 and 15% respectively. Calculated across localities, NK Adagio CL and AGSUN 8251 had the highest protein content (20%) and PAN 7049 the lowest (18%).

Oil yield

Oil yield per unit area is the product of grain yield and seed oil content and it is presented in Table 8. The performance of cultivars regarding oil yield is important to farmers who are compensated for seed oil concentration.

The oil yield for cultivars at the eight localities varied from 0.2 to 1.4 t ha^{-1} with an overall mean of 0.8 t ha^{-1}. The locality with the highest mean oil yield was Boskop at 1.3 t ha^{-1}. Among cultivars, P65LL02, P65LL14, PAN 7049, PAN 7080, PAN 7160 CLP and PHB 65A70 had equally high values of 0.9 t ha^{-1}.

Seed yield

The mean seed yield of cultivars at the respective localities is presented in Table 7. The highest locality mean yield of 3.12 t ha^{-1} was obtained at Boskop planted on 1st October 2015 and the lowest of 0.79 t ha^{-1}, at Reitz.

The six best performing cultivars, in terms of average yield calculated over localities, were PAN 7080, P 65LL14, P 65LC54, PAN 7160 CLP, P 65LL02 and PAN 7095 CL. The overall mean yield for 2015/2016 was 1.96 t ha^{-1}, 11% lower than the mean yield of 2014/2015.

No high oleic cultivars were entered for evaluation in 2015/2016. Six Clearfield cultivars, NK ADAGIO CL, P 65LC54, PAN 7095 CL, PAN 7102 CLP, PAN 7160 CLP and SY 3970 CL were entered. Four of these cultivars namely, P 65LC54, PAN 7095 CL, PAN 7102 CLP and PAN 7160 CLP had yields higher than the overall mean yield of all cultivars.

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 2015/16 are shown in Figure 1, and for the 14 cultivars evaluated in 2014/15 and 2015/16 in Figure 2.

The yield stability of cultivars varied up to 13 fold among cultivars (Table 10). Cultivars, which had exceptionally high stabilities (D-parameter ≤ 0.02) were, AGSUN 5264, Agsun 5270, Agsun 8251, PAN 7049, PAN 7100 and PAN 7102 CLP.

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 21 cultivars for 2015/16 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 14 cultivars evaluated in 32 trials in 2013/14 and 2014/15, are shown in Table 12. Tables 11 and 12 should be used jointly for cultivar selection.

Acknowledgements

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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 germination rate and supplier company 2015/2016

Cultivar	Germinated (%)*			Company
	Normal	*Abnormal*	*Dormant/dead*	
AGSUN 5264	93	5	2	Agricol ♠
AGSUN 5270	98	1	1	
AGSUN 5272	99	0	1	
AGSUN 5273	99	0	1	
AGSUN 5278	98	2	0	
AGSUN 5279	95	4	1	
AGSUN 8251	99	1	0	
PAN 7049	99	1	0	Pannar ●
PAN 7080	97	2	1	
PAN 7095 CL	97	2	1	
PAN 7098	97	2	1	
PAN 7100	96	2	2	
PAN 7102 CLP	99	1	0	
PAN 7160 CLP	96	3	1	
PHB 65A70	94	4	2	Pioneer ♟
P 65LC54	65	4	31	
P 65LL02	95	4	1	
P 65LL14	86	7	7	
NK ADAGIO CL	91	6	3	Syngenta ◘
SY 3970 CL	94	4	2	
SY 4045	95	4	1	

Table 2 Collaborating company, trial localities and responsible co-workers 2015/2016

Company	Localities	Planting dates	Co-workers	E-mail address of co-worker
Agricol ♠	Boskop x 2	01/11/15, 01/12/15	J Swanepoel	Jouberts@agricol.co.za
ARC-GCI ▲	Potchefstroom x 2	11/11/2015, 11/1/16	W Deale & J Erasmus	Erasmusj@arc.agric.za
PANNAR ●	Delmas	26/11/15	L Schoonraad & TC Lochner	Louis.schoonraad@pannar.co.za Ruaan.lochner@pannar.co.za
	Kroonstad	14/01/16		
	Senekal	14/01/16		
Pioneer ♗	Reitz	09/12/15	Martin Brandt	Martin.brandt@pioneer.com
Syngenta ◘	Bethlehem	15/1/16	F van Deventer J Viljoen	Francois.van_deventer@syngenta.com Johannes.viljoen@syngenta.com
	Bothaville	18/12/15		
	Marquart	26/1/16		

Table 3 Trial site information 2015/2016

Locality*	Planting date	Plant population ha^{-1}	Soil classification	Top soil analysis (mg kg^{-1})					Fertiliser applied (kg ha^{-1})	Row width (cm)	Weed contol and insecticides	Nett plot size (m^2)
				pH (KCl)	P	K	Ca	Mg				
Bethlehem ◘	15/01/16	-	-						25 N, 8 P, 4 K	-	Cruiser, Metolachlor, Boron	12.7
Boskop ♠	01/11/15											11.5
Boskop ♠	01/12/15											11.5
Bothaville ◘	18/12/15								80 N, 20 P, 12 K		Alanex, Razer	14.0
Delmas ●	26/11/15											13.7
Kroonstad ●	14/01/16											13.7
Marquart ◘	26/01/16	43 000	Clovelly	-	-	-	-	-		-	-	11.9
Potchefstroom ▲	11/11/15	38 000	Westleigh	6.14	27	110	905	385	N 41; P 9; K 4	90	Alanex 480 CS, Razer, Karate	14.4
Potchefstroom ▲	11/01/16	40 000	Clovelly	6.54	24	143	1020	513	N 41; P 9; K 4	90	Alanex 480 CS, Razer, Karate	14.4
Reitz ♗	09/12/15	40 000	Loam						N 58, P 16, K 8, S38	-	Guardian, Super Metrin	13.2
Senekal ●	14/01/16											17.3

** ♠ Agricol; ▲ ARC-GCI; ● Pannar; ◘ Syngenta*

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

Cultivar	Potchefstroom ▲ 11/11/2015	Potchefstroom ▲ 11/1/16	Potchefstroom ▲ 15/1/16	Mean
AGSUN 5264	68	62	60	63
AGSUN 5270	64	63	62	63
AGSUN 5272	67	66	64	66
AGSUN 5273	69	65	65	66
AGSUN 5278	69	65	66	67
AGSUN 5279	64	63	62	63
AGSUN 8251	68	66	66	67
NK ADAGIO CL	67	64	64	65
P 65LC54	64	66	66	65
P 65LL02	70	67	66	68
P 65LL14	67	66	63	65
PAN 7049	66	66	65	66
PAN 7080	66	67	66	66
PAN 7095 CL	68	62	65	65
PAN 7098	66	63	64	64
PAN 7100	65	65	66	65
PAN 7102 CLP	63	62	66	64
PAN 7160 CLP	65	64	66	65
PHB 65A70	65	63	63	64
SY 3970 CL	69	67	65	67
SY 4045	65	56	60	60
Mean	66	64	64	

Table 5 The moisture free seed oil concentration (%) of cultivars at selected localities 2015/2016

Cultivar	Bethlehem ▫ 15/1/16	Boskop ♣ 01/11/15	Boskop ♣ 01/12/15	Bothaville ▫ 18/12/15	Delmas ● 26/11/15	Kroonstad ● 14/01/16	Potchefstroom ◀ 11/11/2015	Potchefstroom ◀ 11/1/16	Reitz ♟ 09/12/15	Senekal ● 14/01/16	Mean
AGSUN 5264	38.9	41.8	40.7	41.3	40.4	45.7	46.7	48.7	47.8	44.5	43.7
AGSUN 5270	36.0	41.1	38.2	45.3	36.5	43.1	44.4	48.8	44.1	40.3	41.8
AGSUN 5272	37.2	37.1	36.7	39.2	36.6	42.2	41.3	45.0	43.0	38.8	39.7
AGSUN 5273	43.5	37.2	37.8	42.6	37.8	43.4	42.5	40.0	42.9	39.1	40.7
AGSUN 5278	35.2	39.2	37.7	42.9	38.4	38.7	41.9	44.1	41.1	37.0	39.6
AGSUN 5279	39.0	40.1	36.3	39.9	36.4	42.3	41.8	46.1	42.3	40.0	40.4
AGSUN 8251	42.1	39.0	36.7	40.1	35.7	41.0	39.8	42.6	41.3	37.4	39.6
NK ADAGIO CL	42.3	39.7	40.0	41.2	38.4	40.2	44.0	46.1	44.1	40.7	41.7
P 65LC54	45.3	37.7	38.1	39.6	33.2	40.0	41.8	42.2	40.4	40.0	39.8
P 65LL02	35.7	43.2	42.7	37.6	42.5	43.6	46.0	47.2	49.1	43.0	43.1
P 65LL14	38.1	43.2	39.4	40.4	36.4	43.7	45.6	48.7	44.3	38.6	41.8
PAN 7049	38.0	39.9	36.6	50.1	39.0	40.5	43.9	44.4	43.3	39.8	41.6
PAN 7080	37.9	41.1	37.0	39.8	34.2	41.6	41.3	45.2	41.5	37.2	39.7
PAN 7095 CL	39.5	42.1	40.0	37.8	36.8	41.9	39.7	49.1	42.3	39.8	40.9
PAN 7098	36.8	37.3	36.2	39.9	37.2	38.7	41.5	48.2	41.7	38.9	39.6
PAN 7100	38.7	41.6	38.2	40.6	37.0	41.4	46.9	47.0	45.5	42.2	41.9
PAN 7102 CLP	37.4	39.1	36.1	36.4	32.5	42.5	41.4	46.0	41.4	40.3	39.3
PAN 7160 CLP	35.9	42.8	39.0	42.0	36.1	42.6	45.0	40.4	44.1	40.7	40.9
PHB 65A70	36.4	42.0	37.7	45.2	38.8	40.9	43.3	47.0	43.4	41.4	41.6
SY 3970 CL	36.7	48.8	47.2	40.4	40.3	43.7	48.7	54.3	50.4	45.7	45.6
SY 4045	41.0	41.1	36.9	39.8	35.6	44.0	44.9	40.7	44.0	41.6	41.0
Mean	38.6	40.7	38.5	41.1	37.1	42.0	43.4	45.8	43.7	40.3	

Table 6 The moisture free seed protein concentration (%) of cultivars at selected localities 2015/2016

Cultivar	Bethlehem ▫ 15/1/16	Boskop ♣ 01/11/15	Boskop ♣ 01/12/15	Bothaville ▫ 18/12/15	Delmas ● 26/11/15	Kroonstad ● 14/01/16	Potchefstroom ◀ 11/11/2015	Potchefstroom ◀ 11/1/16	Reitz ♟ 09/12/15	Senekal ● 14/01/16	Mean
AGSUN 5264	17.9	21.8	23.3	17.3	21.3	17.0	16.4	20.6	16.3	24.1	19.6
AGSUN 5270	17.1	20.9	22.5	18.2	19.2	18.3	15.4	18.9	15.0	22.7	18.8
AGSUN 5272	18.3	20.5	22.2	19.1	20.5	17.8	15.5	19.0	13.6	19.3	18.6
AGSUN 5273	18.8	22.2	23.2	17.8	20.8	17.9	16.8	20.6	16.0	21.0	19.5
AGSUN 5278	18.8	21.0	22.1	19.8	19.2	19.1	14.7	18.6	15.8	21.4	19.0
AGSUN 5279	17.2	20.8	22.4	16.8	20.8	18.8	16.8	19.5	13.8	21.9	18.9
AGSUN 8251	19.6	20.8	22.5	21.5	21.8	17.0	17.1	19.0	16.9	21.3	19.8
NK ADAGIO CL	17.5	23.6	24.5	17.3	20.8	21.3	16.3	20.1	14.6	22.2	19.8
P 65LC54	18.4	21.5	22.3	17.8	22.1	17.8	14.8	19.2	14.6	19.1	18.8
P 65LL02	17.3	21.0	21.5	20.1	19.4	18.2	14.8	20.3	13.3	21.0	18.7
P 65LL14	17.0	20.8	23.1	19.1	21.5	17.3	13.7	16.7	15.3	21.4	18.6
PAN 7049	18.2	19.6	21.7	17.6	19.5	17.5	13.5	18.0	12.7	20.4	17.9
PAN 7080	18.1	20.4	22.2	18.1	20.4	17.7	15.1	19.1	14.1	21.7	18.7
PAN 7095 CL	17.7	19.4	21.0	17.8	21.8	17.3	16.2	17.9	14.7	19.7	18.4
PAN 7098	18.5	19.3	21.5	17.5	20.4	18.6	14.5	19.5	14.6	20.7	18.5
PAN 7100	18.0	20.4	21.9	16.8	20.5	17.6	14.3	17.6	13.4	19.4	18.0
PAN 7102 CLP	17.0	19.4	23.0	18.0	21.5	17.3	16.5	17.4	14.2	18.6	18.3
PAN 7160 CLP	19.0	19.9	22.1	17.8	20.5	17.5	14.7	18.3	13.5	19.5	18.3
PHB 65A70	17.3	18.8	22.0	18.0	19.0	18.6	14.2	17.3	14.3	20.4	18.0
SY 3970 CL	18.0	18.6	21.7	17.6	21.1	19.1	16.3	19.3	15.4	23.3	19.0
SY 4045	18.2	19.5	21.8	18.9	21.8	18.3	14.2	19.7	14.0	21.0	18.7
Mean	18.0	20.5	22.3	18.2	20.7	18.1	15.3	18.9	14.6	21.0	

Table 7 **Mean seed yield (t ha^{-1}) of cultivars at each locality**

Cultivar	Bethlehem ◘ 15/1/16	Boskop ♣ 01/11/15	Boskop ♣ 01/12/15	Bothaville ◘ 18/12/15	Delmas ● 26/11/15	Kroonstad ● 14/01/16	Marquard ◘ 26/1/16	Potchefstroom ▲ 11/11/2015	Potchefstroom ▲ 11/1/16	Reitz ♟ 09/12/15	Senekal ● 14/01/16
AGSUN 5264	1.57	2.77	2.78	2.32	1.51	1.70	1.62	2.21	1.29	0.84	0.98
AGSUN 5270	1.74	3.16	2.99	3.07	1.69	1.93	1.89	2.29	1.30	0.73	0.98
AGSUN 5272	1.61	3.50	3.26	2.49	1.43	2.33	1.85	2.22	1.49	0.85	1.04
AGSUN 5273	1.61	3.03	2.92	3.12	1.34	2.23	1.58	2.24	1.41	0.75	1.06
AGSUN 5278	1.45	3.53	2.90	1.79	1.73	1.82	1.85	2.37	1.46	0.87	1.07
AGSUN 5279	1.78	3.05	2.86	2.16	1.56	1.77	1.55	2.31	1.28	0.65	1.11
AGSUN 8251	1.67	3.31	3.01	2.76	1.59	1.89	1.74	2.37	1.43	0.89	1.08
NK ADAGIO CL	1.96	2.95	2.53	1.91	1.52	1.74	1.51	1.92	1.45	0.59	0.90
P 65LC54	1.87	2.66	2.73	3.02	2.07	2.17	2.12	2.60	1.66	0.90	1.24
P 65LL02	1.93	3.35	3.00	3.03	1.32	2.29	2.12	2.46	1.27	0.91	1.18
P 65LL14	2.15	3.00	2.64	3.47	1.69	2.37	1.80	2.66	1.57	0.75	1.00
PAN 7049	1.71	3.31	2.82	3.16	1.42	2.07	1.67	2.72	1.45	0.74	1.12
PAN 7080	1.75	3.29	2.97	3.60	1.70	2.40	1.58	2.61	1.38	0.95	1.20
PAN 7095 CL	1.81	3.24	2.79	3.38	1.42	2.17	1.94	2.61	1.39	1.03	0.93
PAN 7098	1.81	3.06	2.92	2.71	1.81	2.55	1.45	2.39	1.55	0.88	1.16
PAN 7100	1.94	2.92	2.87	2.79	1.70	1.97	1.66	2.58	1.53	0.69	1.12
PAN 7102 CLP	1.95	3.14	2.91	2.84	1.52	2.24	1.95	2.45	1.84	0.67	1.09
PAN 7160 CLP	1.81	3.55	2.96	3.06	1.63	2.39	1.70	2.20	1.61	0.87	1.16
PHB 65A70	1.95	2.91	2.83	3.10	1.73	2.08	1.65	2.65	1.66	0.73	0.88
SY 3970 CL	1.30	2.65	2.80	2.79	1.17	1.84	1.69	2.15	1.15	0.64	0.47
SY 4045	1.27	3.08	2.62	1.85	1.34	1.36	1.41	2.80	1.31	0.64	0.75
Mean	1.75	3.12	2.86	2.78	1.57	2.06	1.73	2.42	1.45	0.79	1.02
CV%	16.0	16.0	12.2	16.8	11.2	9.2	10.8	9.3	19.7	12.0	9.8

Table 8 Oil yield (t ha-1) of cultivars at selected localities 2015/2016

Cultivar	Bethlehem ◘ 15/1/16	Boskop ♣ 01/11/15	Boskop ♣ 01/12/15	Bothaville ◘ 18/12/15	Delmas ● 26/11/15	Kroonstad ● 14/01/16	Potchefstroom ◄ 11/11/2015	Potchefstroom ◄ 11/1/16	Reitz ♣ 09/12/15	Senekal ● 14/01/16	Mean
AGSUN 5264	0.6	1.2	1.1	1.0	0.6	0.8	1.0	0.6	0.4	0.4	0.8
AGSUN 5270	0.6	1.3	1.1	1.4	0.6	0.8	1.0	0.6	0.3	0.4	0.8
AGSUN 5272	0.6	1.3	1.2	1.0	0.5	1.0	0.9	0.7	0.4	0.4	0.8
AGSUN 5273	0.7	1.1	1.1	1.3	0.5	1.0	1.0	0.6	0.3	0.4	0.8
AGSUN 5278	0.5	1.4	1.1	0.8	0.7	0.7	1.0	0.6	0.4	0.4	0.8
AGSUN 5279	0.7	1.2	1.0	0.9	0.6	0.7	1.0	0.6	0.3	0.4	0.7
AGSUN 8251	0.7	1.3	1.1	1.1	0.6	0.8	0.9	0.6	0.4	0.4	0.8
NK ADAGIO CL	0.8	1.2	1.0	0.8	0.6	0.7	0.8	0.7	0.3	0.4	0.7
P 65LC54	0.8	1.0	1.0	1.2	0.7	0.9	1.1	0.7	0.4	0.5	0.8
P 65LL02	0.7	1.4	1.3	1.1	0.6	1.0	1.1	0.6	0.4	0.5	0.9
P 65LL14	0.8	1.3	1.0	1.4	0.6	1.0	1.2	0.8	0.3	0.4	0.9
PAN 7049	0.6	1.3	1.0	1.6	0.6	0.8	1.2	0.6	0.3	0.4	0.9
PAN 7080	0.7	1.4	1.1	1.4	0.6	1.0	1.1	0.6	0.4	0.4	0.9
PAN 7095 CL	0.7	1.4	1.1	1.3	0.5	0.9	1.0	0.7	0.4	0.4	0.8
PAN 7098	0.7	1.1	1.1	1.1	0.7	1.0	1.0	0.7	0.4	0.5	0.8
PAN 7100	0.8	1.2	1.1	1.1	0.6	0.8	1.2	0.7	0.3	0.5	0.8
PAN 7102 CLP	0.7	1.2	1.1	1.0	0.5	1.0	1.0	0.8	0.3	0.4	0.8
PAN 7160 CLP	0.6	1.5	1.2	1.3	0.6	1.0	1.0	0.7	0.4	0.5	0.9
PHB 65A70	0.7	1.2	1.1	1.4	0.7	0.9	1.1	0.8	0.3	0.4	0.9
SY 3970 CL	0.5	1.3	1.3	1.1	0.5	0.8	1.0	0.6	0.3	0.2	0.8
SY 4045	0.5	1.3	1.0	0.7	0.5	0.6	1.3	0.5	0.3	0.3	0.7
Mean	0.7	1.3	1.1	1.1	0.6	0.9	1.0	0.7	0.3	0.4	

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
Bethlehem ◘ 15/01/2016	1.745	0.16	16	8.6	0.23	0.145	0.47
Boskop ♠ 01/11/2015	3.117	0.29	16	<0.1	-0.06	0.120	-0.2
Boskop ♠ 01/12/2015	2.862	0.20	12	<0.1	-0.14	0.106	-0.58
Bothaville ◘ 18/12/2015	2.782	0.27	17	16	0.48	0.132	0.73
Delmas ● 26/11/2015	1.566	0.10	11	11.2	0.50	0.129	0.75
Kroonstad ●14/01/2016	2.062	0.11	9	13.3	0.68	0.097	0.86
Marquard ◘ 26/01/2016	1.728	0.11	11	9.6	0.44	0.136	0.7
Potchefstroom ▲ 11/11/2015	2.420	0.13	9	7.5	0.40	0.139	0.67
Potchefstroom ▲ 11/01/2016	1.451	0.17	20	<0.1	-0.01	0.128	-0.03
Reitz ✪ 09/12/15	0.789	0.05	12	13.7	0.56	0.120	0.79
Senekal ● 14/01/2016	1.024	0.06	10	15.9	0.73	0.086	0.89

♠ Agricol; ▲ ARC-GCI; ● Pannar; ✪ Pioneer, ◘ Syngenta

Table 10 Regression line coordinates at different yield potentials 2015/2016

Cultivar	Yield potential (t ha^{-1})						Average	Intercept	Slope	D-parameter
	1	1.5	2	2.5	3	3.5				
AGSUN 5264	0.97	1.40	1.83	2.26	2.69	3.12	1.78	0.11	0.86	0.01
AGSUN 5270	0.94	1.48	2.01	2.55	3.08	3.62	1.98	-0.13	1.07	0.02
AGSUN 5272	0.98	1.52	2.06	2.60	3.14	3.68	2.01	-0.10	1.08	0.06
AGSUN 5273	0.92	1.45	1.98	2.51	3.04	3.57	1.94	-0.14	1.06	0.03
AGSUN 5278	1.02	1.48	1.93	2.39	2.84	3.30	1.89	0.11	0.91	0.14
AGSUN 5279	0.94	1.40	1.86	2.32	2.78	3.24	1.83	0.02	0.92	0.04
AGSUN 8251	0.99	1.50	2.01	2.52	3.03	3.54	1.98	-0.03	1.02	0.01
NK ADAGIO CL	0.95	1.36	1.76	2.17	2.57	2.98	1.73	0.14	0.81	0.07
P 65LC54	1.32	1.73	2.13	2.54	2.94	3.35	2.09	0.51	0.81	0.05
P 65LL02	1.05	1.59	2.12	2.66	3.19	3.73	2.08	-0.02	1.07	0.04
P 65LL14	1.10	1.62	2.14	2.66	3.18	3.70	2.10	0.06	1.04	0.07
PAN 7049	0.95	1.51	2.07	2.63	3.19	3.75	2.02	-0.17	1.12	0.02
PAN 7080	1.05	1.62	2.18	2.75	3.31	3.88	2.13	-0.08	1.13	0.06
PAN 7095 CL	1.03	1.58	2.12	2.67	3.21	3.76	2.06	-0.06	1.09	0.05
PAN 7098	1.13	1.60	2.07	2.54	3.01	3.48	2.03	0.19	0.94	0.04
PAN 7100	1.06	1.54	2.02	2.50	2.98	3.46	1.98	0.10	0.96	0.02
PAN 7102 CLP	1.10	1.60	2.09	2.59	3.08	3.58	2.05	0.11	0.99	0.02
PAN 7160 CLP	1.06	1.60	2.13	2.67	3.20	3.74	2.09	-0.01	1.07	0.03
PHB 65A70	1.04	1.55	2.06	2.57	3.08	3.59	2.02	0.02	1.02	0.03
SY 3970 CL	0.67	1.20	1.73	2.26	2.79	3.32	1.70	-0.39	1.06	0.04
SY 4045	0.74	1.23	1.71	2.20	2.68	3.17	1.68	-0.23	0.97	0.13

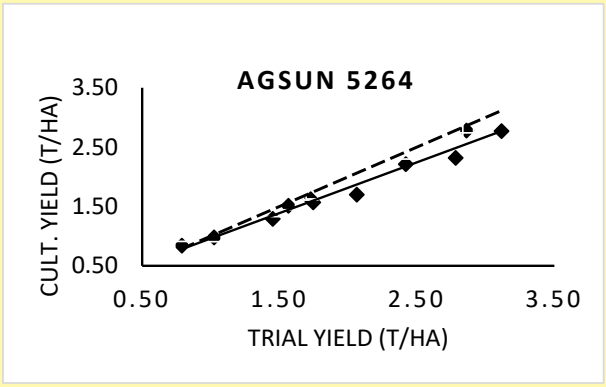
Table 11 Yield probability (%) of cultivars 2015/2016 at different yield potentials

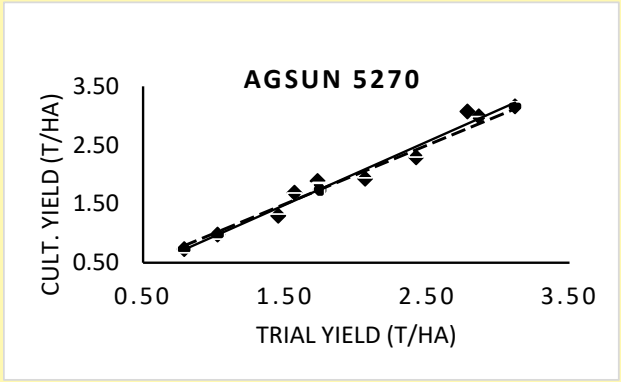
Cultivar	Yield potential (t ha^{-1})					
	1	1.5	2	2.5	3	3.5
AGSUN 5264	41	20	8	2	1	0
AGSUN 5270	35	45	53	63	70	76
AGSUN 5272	47	53	60	65	70	73
AGSUN 5273	33	39	45	52	58	63
AGSUN 5278	52	48	43	39	35	33
AGSUN 5279	39	31	25	19	16	14
AGSUN 8251	47	50	53	57	60	62
NK ADAGIO CL	43	30	19	11	7	5
P 65LC54	90	84	71	57	41	29
P 65LL02	59	67	73	78	81	84
P 65LL14	63	66	69	71	72	73
PAN 7049	38	53	68	80	88	92
PAN 7080	57	68	76	83	87	90
PAN 7095 CL	55	64	71	77	81	84
PAN 7098	72	68	63	58	52	47
PAN 7100	66	62	56	50	44	40
PAN 7102 CLP	73	74	72	72	68	67
PAN 7160 CLP	62	70	76	82	84	87
PHB 65A70	58	60	62	64	65	65
SY 3970 CL	6	7	9	12	17	22
SY 4045	26	24	22	22	22	23

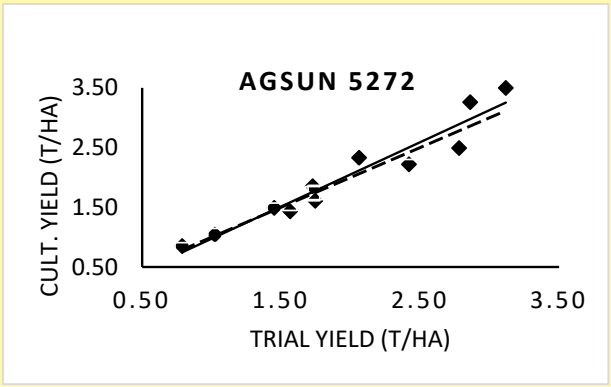
Table 12 Yield probability (%) of cultivars 2014/2015 and 2015/2016 at different yield potentials

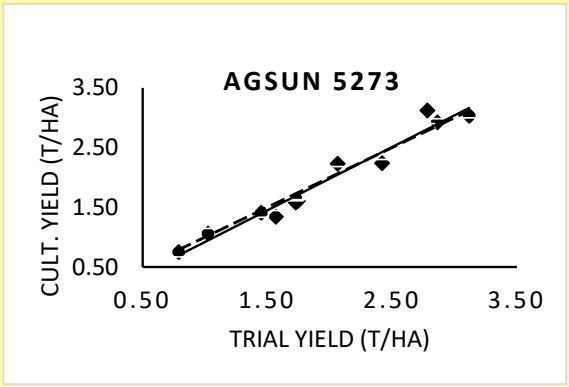
Cultivar	Yield potential (t ha^{-1})					
	1	1.5	2	2.5	3	3.5
AGSUN 5264	31	26	22	18	15	12
AGSUN 5272	48	48	48	48	48	48
AGSUN 5278	39	44	48	53	58	62
AGSUN 5279	44	48	50	54	56	60
AGSUN 8251	42	48	54	60	66	71
NK ADAGIO CL	30	19	11	6	3	2
PAN 7049	53	65	77	85	91	95
PAN 7080	72	75	78	80	82	83
PAN 7095 CL	75	74	71	70	66	65
PAN 7098	82	83	82	82	80	80
PAN 7102 CLP	72	75	77	79	81	82
PHB 65A70	67	68	69	70	70	71
SY 3970 CL	18	19	18	20	20	22
SY 4045	34	30	26	23	21	19

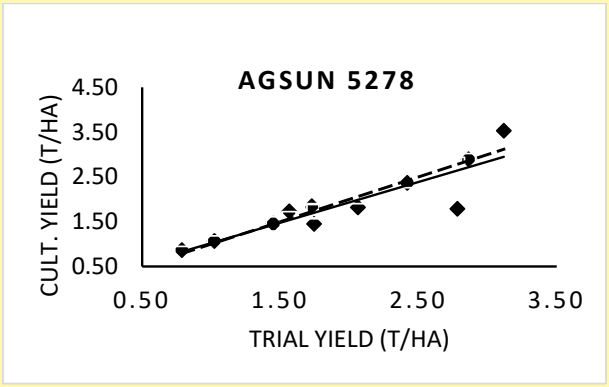
Figure 1 Regression lines for cultivars 2015/2016

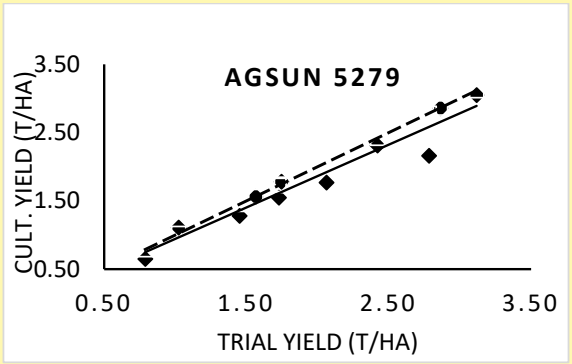


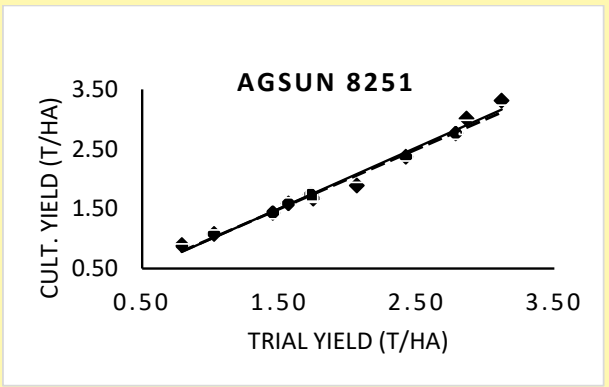


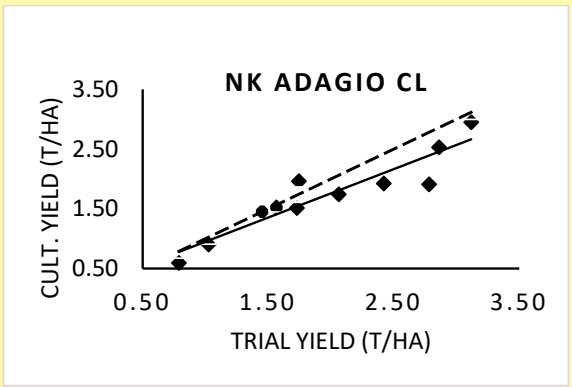


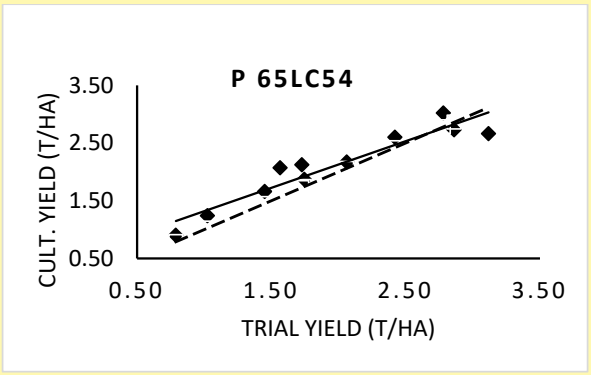


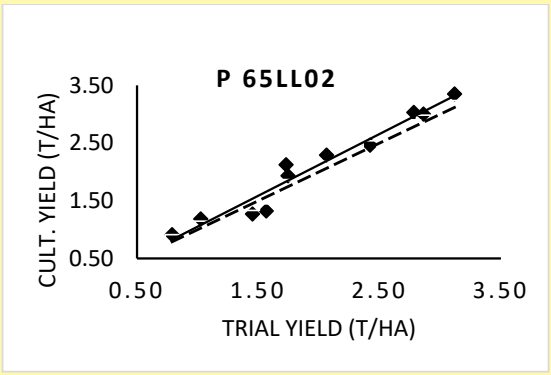









P 65LC54
CULT. YIELD (T/HA)
3.50
2.50
1.50
0.50
0.50
1.50
2.50
3.50
TRIAL YIELD (T/HA)


P 65LL02
CULT. YIELD (T/HA)
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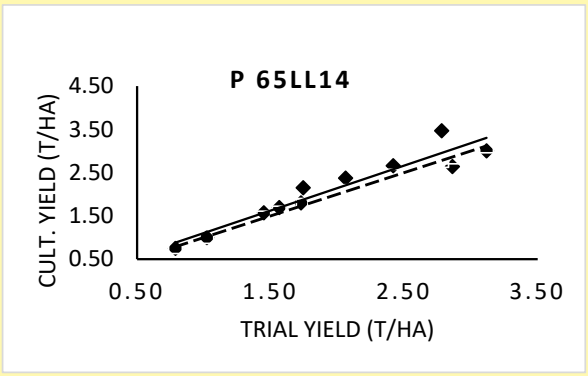
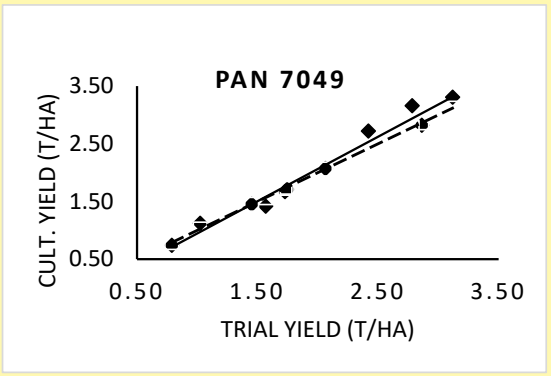
2.50
1.50
0.50
0.50
1.50
2.50
3.50
TRIAL YIELD (T/HA)


P 65LL14
CULT. YIELD (T/HA)
4.50
3.50
2.50
1.50
0.50
0.50
1.50
2.50
3.50
TRIAL YIELD (T/HA)


PAN 7049
CULT. YIELD (T/HA)
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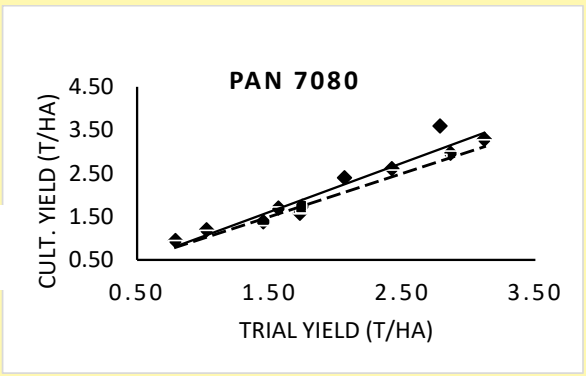
2.50
1.50
0.50
0.50
1.50
2.50
3.50
TRIAL YIELD (T/HA)


PAN 7080
CULT. YIELD (T/HA)
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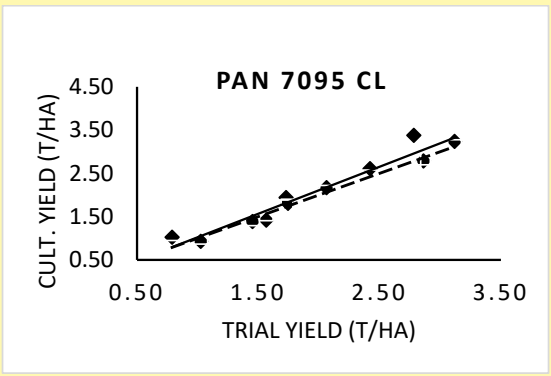
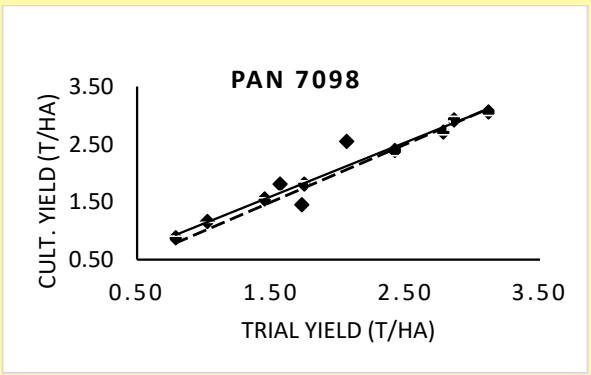
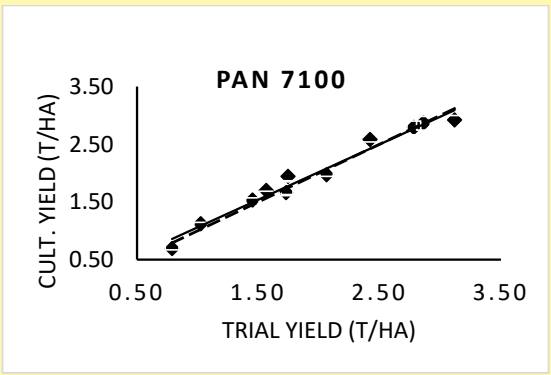
3.50
2.50
1.50
0.50
0.50
1.50
2.50
3.50
TRIAL YIELD (T/HA)


PAN 7095 CL
CULT. YIELD (T/HA)
4.50
3.50
2.50
1.50
0.50
0.50
1.50
2.50
3.50
TRIAL YIELD (T/HA)


PAN 7098
CULT. YIELD (T/HA)
3.50
2.50
1.50
0.50
0.50
1.50
2.50
3.50
TRIAL YIELD (T/HA)


PAN 7100
CULT. YIELD (T/HA)
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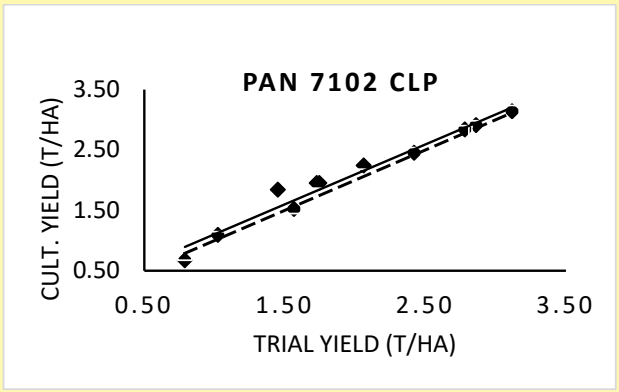
2.50
1.50
0.50
0.50
1.50
2.50
3.50
TRIAL YIELD (T/HA)


PAN 7102 CLP
CULT. YIELD (T/HA)
TRIAL YIELD (T/HA)
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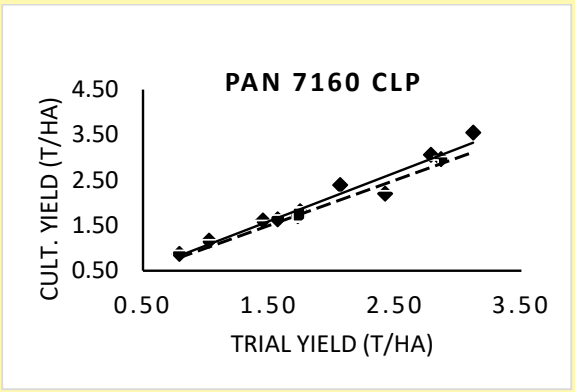
2.50
1.50
0.50
0.50
1.50
2.50
3.50


PAN 7160 CLP
CULT. YIELD (T/HA)
TRIAL YIELD (T/HA)
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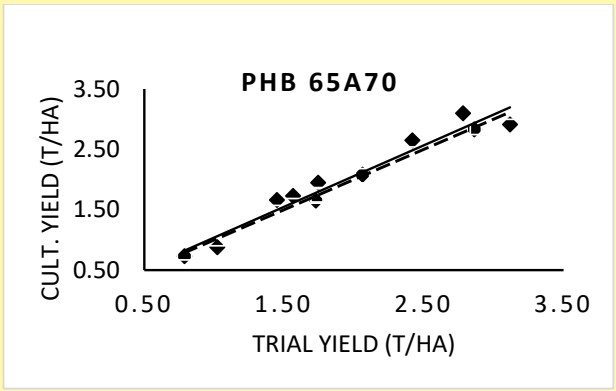
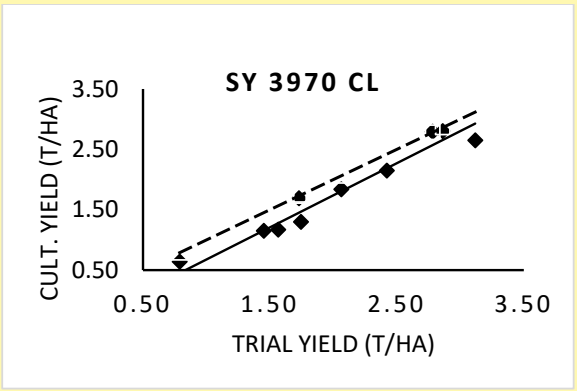
3.50
2.50
1.50
0.50
0.50
1.50
2.50
3.50


PHB 65A70
CULT. YIELD (T/HA)
TRIAL YIELD (T/HA)
3.50
2.50
1.50
0.50
0.50
1.50
2.50
3.50


SY 3970 CL
CULT. YIELD (T/HA)
TRIAL YIELD (T/HA)
3.50
2.50
1.50
0.50
0.50
1.50
2.50
3.50

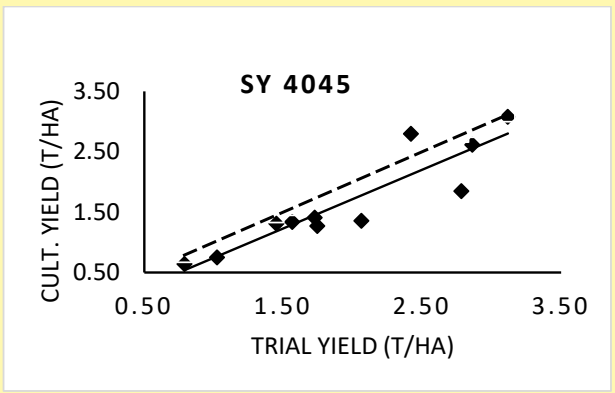
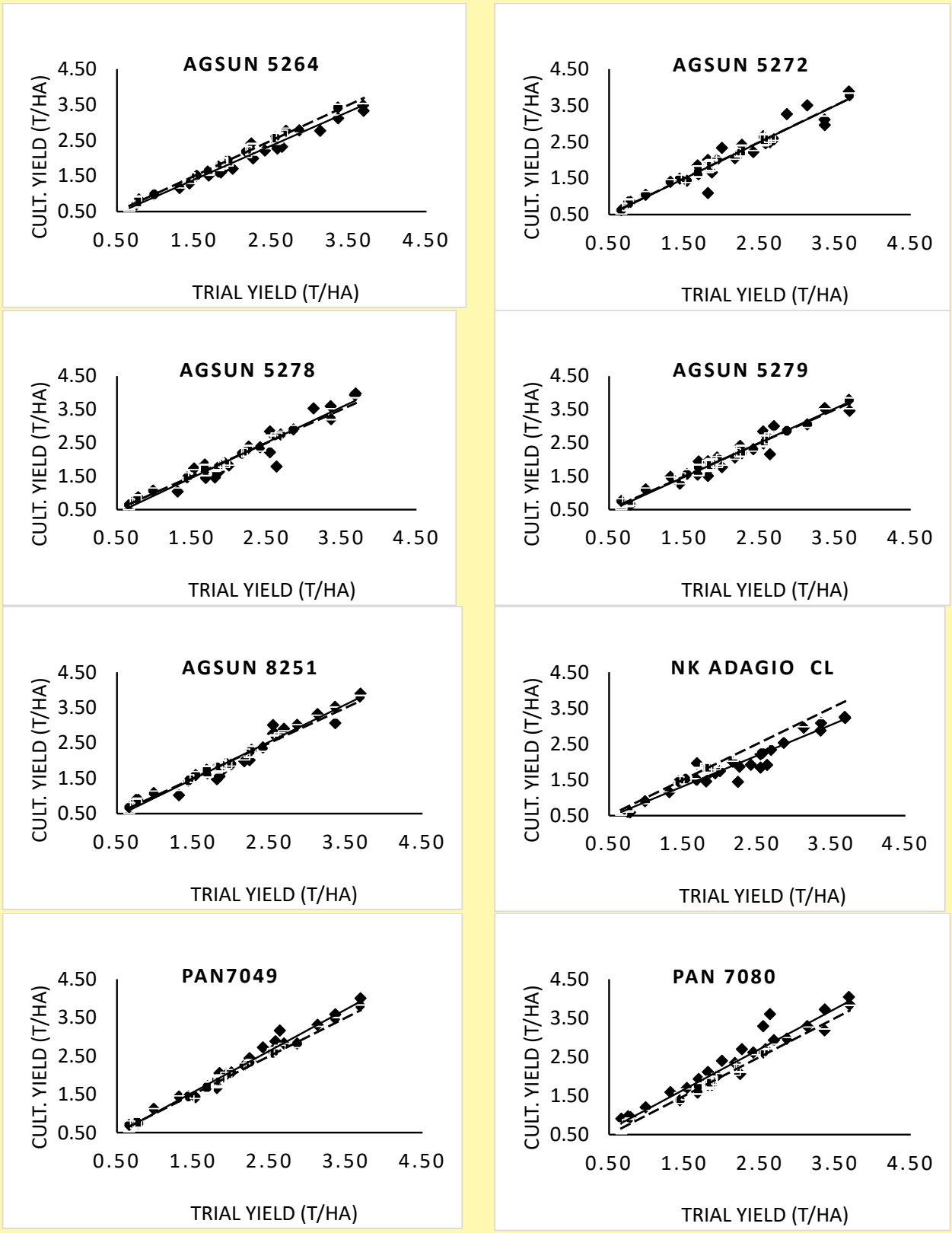
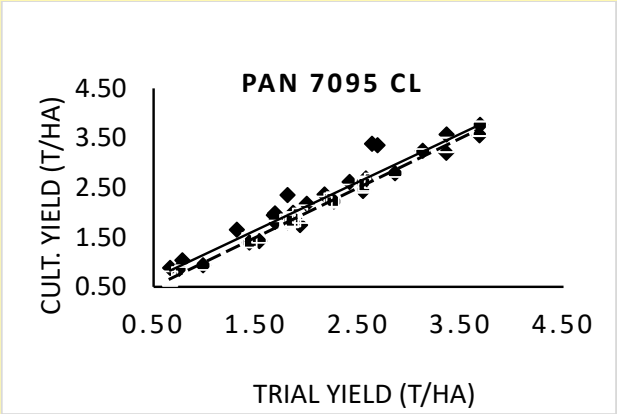

SY 4045
CULT. YIELD (T/HA)
TRIAL YIELD (T/HA)
3.50
2.50
1.50
0.50
0.50
1.50
2.50
3.50

Figure 2 Regression lines for cultivars 2014/2015 and 2015/2016




PAN 7095 CL
CULT. YIELD (T/HA)
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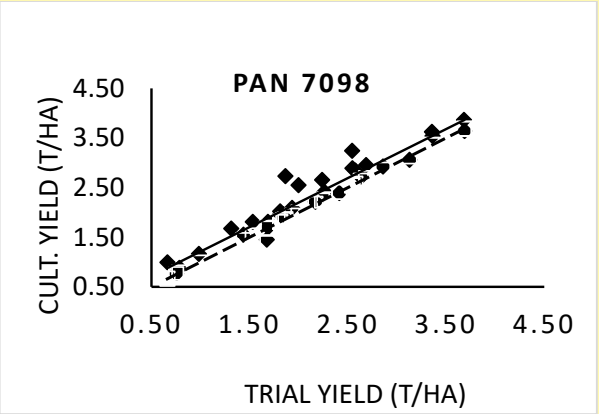
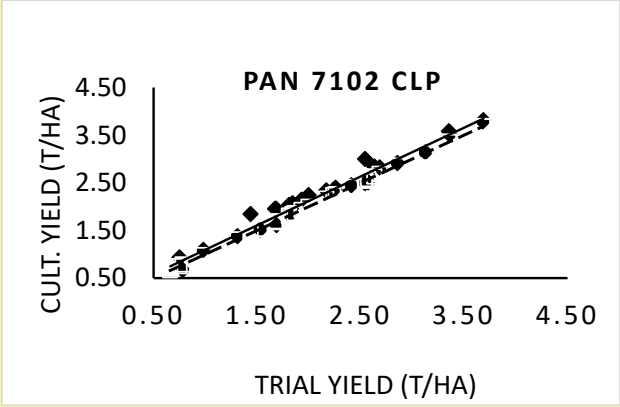
3.50
2.50
1.50
0.50
0.50 1.50 2.50 3.50 4.50
TRIAL YIELD (T/HA)


PAN 7098
CULT. YIELD (T/HA)
4.50
3.50
2.50
1.50
0.50
0.50 1.50 2.50 3.50 4.50
TRIAL YIELD (T/HA)


PAN 7102 CLP
CULT. YIELD (T/HA)
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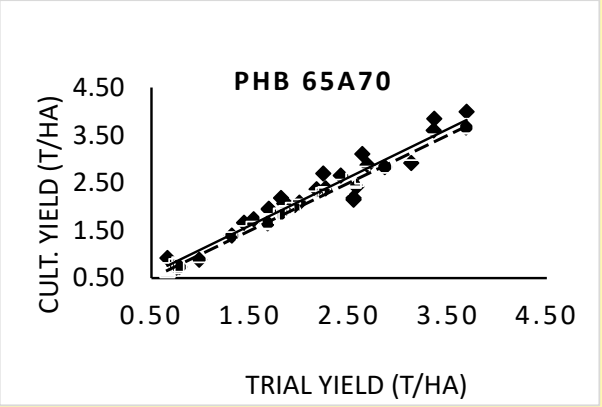
3.50
2.50
1.50
0.50
0.50 1.50 2.50 3.50 4.50
TRIAL YIELD (T/HA)


PHB 65A70
CULT. YIELD (T/HA)
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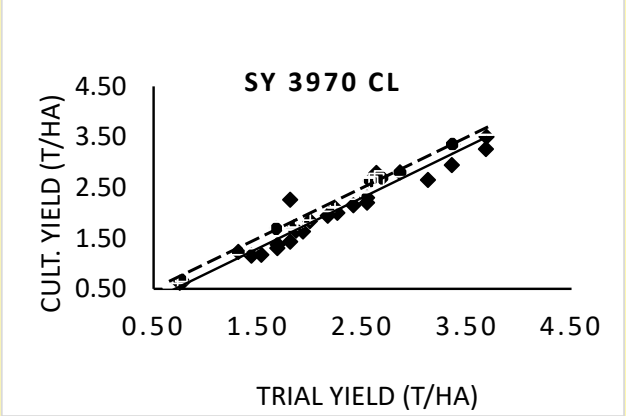
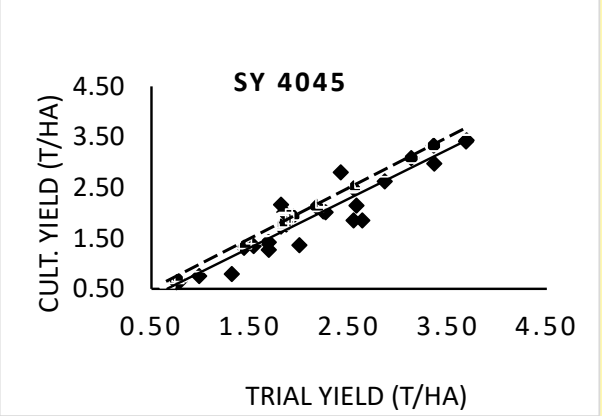
3.50
2.50
1.50
0.50
0.50 1.50 2.50 3.50 4.50
TRIAL YIELD (T/HA)


SY 3970 CL
CULT. YIELD (T/HA)
4.50
3.50
2.50
1.50
0.50
0.50 1.50 2.50 3.50 4.50
TRIAL YIELD (T/HA)


SY 4045
CULT. YIELD (T/HA)
4.50
3.50
2.50
1.50
0.50
0.50 1.50 2.50 3.50 4.50
TRIAL YIELD (T/HA)

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.