Report

Evaluation of sunflower cultivars: 2016/2017 season

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

This report, included in the South African Sunflower Crop Quality Report of the 2016/2017 season, is published in totality as received from ARC-Grain Crops.

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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 2016/2017 season with the voluntary collaboration of Agricol, Pannar, Pioneer and AGT. Seed companies entered 18 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). 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.

Four of the 18 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 6 trials, Pannar with 7, Pioneer with 4 and AGT with 1. Four trials were planted by the ARC-GCI. Trial sites were selected by collaborators and the co-workers involved are listed in Table 2.

Eight trials were not successful due to 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 three trials at Potchefstroom and two trials at Boskop and one trial at Ventersdorp.

Yield data and seed samples were send by collaborators to ARC-GCI for analyses. Seed from selected trials sent to SAGL for oil and protein content analyses. Yield data from 14 field trials were subjected to analyses of variance. Results from 1 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 13 trials.

Yield probabilities were also calculated for 15 cultivars that were evaluated in 24 trials during 2015/2016 and 2016/2017.

RESULTS

Days from planting to flowering

The mean number of days from planting to 50% flowering of cultivars (Table 4) ranged from 67 (AGSUN 5264 and PHB 65A70) to 69 days (PAN 7080, PAN 7102 CLP, PAN 7156 CLP and SV 60064). Calculated across cultivars and planting dates, the period from planting to flowering was 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 moisture free oil content for cultivars at the various localities varied from 36 to 54% with an overall mean of 42%. Adjusted for a moisture content of 9% at which sunflower grain is traded, the overall mean would be about 38%.

The highest mean oil concentration among localities was at Senekal (planting date 15 December 2016) with 47.8%. The locality with the lowest mean oil content of 42% was Potchefstroom planting date was January 19, 2017. The highest oil concentration among cultivars and calculated across localities, was SV 60064 at 46.2% followed by AGSUN 5264 at 45.9%

The average protein content varied from 18.3 to 20.5% among cultivars at the different

localities. Among localities, Potchefstroom planted in January 19, 2017 had the highest and Senekal the lowest protein content of 22.5 and 14.9% respectively. Calculated across localities, AGSUN 5273 had the highest protein content (20.5%) followed by AGSUN 5264 (20.1) while PAN 7080 and PAN 7095 CL the lowest (18.3%).

Seed yield

The mean seed yield of cultivars at the respective localities is presented in Table 7. The highest locality mean yield of 3.27 t ha^{-1} was obtained at Bainsvlei planted on 20th December 2016 and the lowest of 1.38 t ha^{-1}, at Potchefstroom planted 19th of January 2017.

The six best performing cultivars, in terms of average yield calculated over localities, were PAN 7160 CLP, PAN 7102 CLP, PAN 7100, AGSUN 5272 and AGSUN 8251. The overall mean yield for 2016/2017 was 2.25 t ha^{-1}, 13 % higher than the mean yield of 2015/2016.

No high oleic cultivars were entered for evaluation in 2016/2017. Four Clearfield cultivars, PAN 7095 CL, PAN 7102 CLP, PAN 7156 and PAN 7160 CLP were entered. Two of these cultivars namely, PAN 7160 CLP and PAN 7102 CLP had 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 eight localities varied from 0.93 to 1.27 t ha^{-1} with an overall mean of 0.93 t ha^{-1}. The locality with the highest mean oil yield was Boskop and Potchefstroom planted in December 18, 2016 at 1.4 t ha^{-1}. Among cultivars, PAN 7100, PAN 7102 CLP and PAN 7160 CLP had equally high values of 1.3 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 (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 2016/17 are shown in Figure 1 and for the 15 cultivars evaluated in 2015/16 and 2016/17 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, P 65LL02, AGSUN 5278, P 65LL02, and P 65LP54.

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 18 cultivars for 2016/17 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 15 cultivars evaluated in 23 trials in 2015/16 and 2016/17, 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 2016/2017**

Cultivar	Germinated (%)*			Company
	Normal	Abnormal	Dormant/dead	
AGSUN 5264	97	2	1	Agricol ♠
AGSUN 5270	90	-	10	
AGSUN 5272	97	2	1	
AGSUN 5273	98	1	1	
AGSUN 5278	97	1	2	
AGSUN 8251	95	1	4	
PAN 7080	99	-	1	Pannar ●
PAN 7095 CL	96	3	1	
PAN 7098	99	1	-	
PAN 7100	100	-	-	
PAN 7102 CLP	92	8	-	
PAN 7156 CLP	99	-	1	
PAN 7160 CLP	98	1	1	
P 65LL02	99	0	1	Pioneer ♗
P 65LL14	84	4	12	
P 65LP54	100	-	-	
PHB 65A70	96	3	1	
SV 60064	95	4	1	AGT ◘

Table 2 Collaborating company, trial localities and responsible co-workers 2016/2017

Company	Localities	Planting dates	Co-workers	E-mail address of co-worker
Agricol ♠	Boskop Boskop Ottosdal Ventersdorp	14/11/2016 13/01/2017 11/01/2017 18/01/2017	J Swanepoel	Jouberts@agricol.co.za
ARC-GCI ▲	Potchefstroom	09/11/2016 23/11/2016 08/12/2016 19/01/2017	W Makgoga & J Erasmus	Makgogamw@arc.agric.za Erasmusj@arc.agric.za
PANNAR ●	Bainsvlei Delmas Senekal	20/12/2016 25/10/2016 15/12/2016	Pretorius, Abre	abre.pretorius@pannar.co.za
Pioneer	Gerdau	03/01/2017	Phillip Fourie	philip.fourie@pioneer.com]
AGT ◘	Bethlehem	-	Gideon Willemse	gideonp.willemse@vodamail.co.za

Table 3 Trial site information 2016/2017

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				
Bainsvlei ●	20/12/2016	42 000	Red Clay	-	-	-	-	-	300 kg 5.3.1	91	Plough & disc	7.28
Bethlehem ◘	?	-	-	-	-	-	-	-	25 N, 8 P, 4 K	-	Cruiser, Metolachlor, Boron	12.7
Boskop ♠	14/11/2016	45000	-	-	-	-	-	-	-	91	-	11.83
Boskop ♠	13/01/2017	45000	-	-	-	-	-	-	-	91	-	11.83
Delmas	25/10/2016	42000	-	-	-	-	-	-	-	91	-	6.82
Gerdau ♣	03/01/2017	45000	Hutton	5.4	-	-	-	-	32.8 N, P 8.2	91	S-metolachor	7.28
Ottosdal ♠	11/01/2017	45000	-	-	-	-	-	-	-	91	-	11.83
Potchefstroom ▲	09/11/2016	38 000	Westleigh	6.14	27	110	905	385	N 41; P 9; K 4	90	Grammoxone	14.4
Potchefstroom ▲	23/11/2016	38 000	Clovelly	6.54	24	143	1020	513	N 41; P 9; K 4	90	Grammoxone	14.4
Potchefstroom ▲	08/12/2016	38 000	Westleigh	6.14	27	110	905	385	N 41; P 9; K 4	90	Grammoxone	14.4
Potchefstroom ▲	19/01/2017	38 000	Clovelly	6.54	24	143	1020	513	N 41; P 9; K 4	90	Grammoxone	14.4
Senekal ●	15/12/2016	42 000	Sandy loam	-	-	-	-	-	-	91	Plough & disc	7.28
Ventersdorp ♠	18/01/2017	45000	-	-	-	-	-	-	-	91	-	11.83

♠ Agricol; ▲ ARC-GCI; ● Pannar; ♣ Pioneer, ◘ AGT Foods

Table 1 Number of days from planting to 50 percent flowering of cultivars at selected localities and planting dates 2016/2017

Cultivar	Boskop ♠ 13/01/2017	Boskop ♠ 14/11/2016	Ottosdal ♠ 11/01/2017	Potchefstroom ◄ 09/11/2016	Potchefstroom ◄ 23/11/2016	Potchefstroom ◄ 08/12/2016	Potchefstroom ◄ 19/01/2017	Ventersdorp ♠ 18/01/2017	Mean
AGSUN 5264	68	65	66	68	66	64	70	67	67
AGSUN 5270	68	67	69	68	66	67	68	70	68
AGSUN 5272	69	68	70	70	63	65	69	70	68
AGSUN 5273	70	68	70	66	63	66	70	71	68
AGSUN 5278	70	66	69	64	68	68	71	70	68
AGSUN 8251	70	65	69	65	65	64	71	71	68
P 65LL02	68	66	69	68	66	65	72	70	68
P 65LL14	71	66	69	69	64	67	71	71	69
P 65LP54	70	67	70	64	64	67	71	71	68
PAN 7080	71	67	70	68	65	67	71	71	69
PAN 7095 CL	69	66	69	68	68	67	68	70	68
PAN 7098	70	66	69	70	64	65	71	70	68
PAN 7100	70	66	69	65	66	67	71	70	68
PAN 7102 CLP	70	65	68	65	64	67	71	70	68
PAN 7156 CLP	71	67	70	67	66	68	72	71	69
PAN 7160 CLP	71	67	70	68	67	67	73	70	69
PHB 65A70	69	65	69	65	68	65	68	70	67
SV 60064	70	66	69	70	68	64	70	71	69
Mean	70	66	69	67	66	66	70	70	68

♠ Agricol; ▲ ARC-GCI; ● Pannar; ♣ Pioneer, ◘ AGT Foods

Table 2 The moisture free seed oil concentration (%) of cultivars at selected localities 2016/2017

Cultivar	Bethlehem ◘	Boskop ♠ 13/01/2017	Gerdau ♣ 3/01/2017	Ottosdal ♠ 11/01/2017	Potchefstroom ▲ 09-11-2016	Potchefstroom ▲ 08/12/2016	Potchefstroom ▲ 19/01/2017	Senekal ●	Mean
AGSUN 5264	45,7	43,2	45,1	44,5	48,1	52,0	38,7	49,6	45,9
AGSUN 5270	46,3	40,5	48,0	46,9	44,0	49,4	37,9	43,8	44,6
AGSUN 5272	44,5	47,8	45,8	41,1	40,8	44,6	36,8	49,6	43,9
AGSUN 5273	41,4	45,2	46,1	40,4	40,7	45,0	35,8	44,4	42,4
AGSUN 5278	48,0	45,0	47,1	41,8	43,8	44,4	44,0	50,1	45,5
AGSUN 8251	44,9	48,2	42,9	40,5	41,5	45,5	39,7	53,5	44,6
P 65LL02	41,6	44,1	40,5	46,4	45,2	49,8	47,6	49,3	45,6
P 65LL14	41,6	47,3	44,6	44,4	46,5	48,4	46,0	46,0	45,6
P 65LP54	43,3	46,7	48,5	42,7	43,6	43,7	41,3	46,8	44,6
PAN 7080	47,0	46,1	43,5	42,9	42,1	47,1	44,1	48,1	45,1
PAN 7095 CL	49,0	44,5	43,7	43,3	43,1	47,2	43,5	45,8	45,0
PAN 7098	44,8	43,0	44,3	43,8	42,7	45,1	41,5	45,3	43,8
PAN 7100	41,0	43,7	43,3	45,3	44,0	48,1	44,0	50,0	44,9
PAN 7102 CLP	41,7	48,7	43,7	45,3	44,4	44,6	41,8	47,2	44,7
PAN 7156 CLP	46,4	45,2	44,9	40,5	43,0	46,5	42,0	47,5	44,5
PAN 7160 CLP	44,6	43,9	43,7	44,2	45,5	50,1	43,1	47,0	45,3
PHB 65A70	42,7	44,0	46,5	44,4	44,9	46,3	39,0	50,0	44,7
SV 60064	43,0	46,1	47,5	44,5	45,3	49,6	48,3	45,6	46,2
Mean	44,3	45,2	45,0	43,5	43,8	47,1	42,0	47,8	

♠ Agricol; ▲ ARC-GCI; ● Pannar; ♣ Pioneer, ◘ AGT Foods

Table 3 The moisture free seed protein concentration (%) of cultivars at selected localities 2016/2017

Cultivar	Bethlehem ◘	Boskop ♠ 13/01/2017	Gerdau ♣ 3/01/2017	Ottosdal ♠ 11/01/2017	Potchefstroom ▲ 09-11-2016	Potchefstroom ▲ 08/12/2016	Potchefstroom ▲ 19/01/2017	Senekal ●	Mean
AGSUN 5264	16,2	23,8	21,4	22,3	19,3	17,6	27,4	13,2	20,1
AGSUN 5270	17,1	21,7	21,9	21,5	18,6	16,8	24,8	15,6	19,7
AGSUN 5272	20,1	21,9	19,1	22,5	18,2	17,7	23,4	13,1	19,5
AGSUN 5273	22,0	22,7	20,0	23,7	16,2	18,0	26,0	15,4	20,5
AGSUN 5278	20,7	21,9	20,6	19,4	15,1	18,3	19,1	14,3	18,7
AGSUN 8251	23,0	22,0	17,5	21,4	19,7	17,8	23,4	15,9	20,1
P 65LL02	18,3	21,4	18,0	20,3	17,2	16,4	21,0	14,4	18,4
P 65LL14	16,1	22,1	21,4	20,7	16,2	17,8	22,0	13,8	18,8
P 65LP54	16,2	23,0	22,4	20,7	17,8	18,6	22,5	15,7	19,6
PAN 7080	14,5	20,7	20,2	20,0	17,3	17,6	20,7	15,1	18,3
PAN 7095 CL	15,7	20,6	18,8	21,3	16,6	16,8	21,8	14,7	18,3
PAN 7098	18,5	20,8	19,8	20,0	15,7	16,8	21,4	18,8	19,0
PAN 7100	21,0	21,2	19,6	18,4	18,5	16,9	20,5	15,5	19,0
PAN 7102 CLP	19,4	22,5	20,3	18,0	17,9	17,7	20,9	13,9	18,8
PAN 7156 CLP	16,8	21,6	19,8	19,8	18,0	16,0	22,7	14,7	18,7
PAN 7160 CLP	17,6	21,8	19,9	19,0	16,2	16,5	22,8	14,4	18,5
PHB 65A70	18,6	21,5	18,2	20,9	17,7	16,7	22,8	14,4	18,9
SV 60064	16,7	22,5	18,9	23,9	19,7	18,1	20,5	16,1	19,5
Mean	18,3	21,9	20,0	20,6	17,4	17,3	22,5	14,9	

♠ Agricol; ▲ ARC-GCI; ● Pannar; ♣ Pioneer, ◘ AGT Foods

Table 4 Mean seed yield (t ha-[1]) of cultivars at each locality 2016/2017

Cultivar	Bainsvlei ● 20/12/2016	Bethlehem ◘	Boskop ♠ 14/11/2016	Boskop ♠ 13/01/2017	Delmas ● 25/10/2016	Gerdau ♗ 3/01/2017	Ottosdal ♠ 11/01/2017	Potchefstroom ▲ 09/11/2016	Potchefstroom ▲ 23/11/2016	Potchefstroom ▲ 08/12/2016	Potchefstroom ▲ 19/01/2017	Senekal ● 15/12/2016	Ventersdorp ♠ 18/01/2017	Mean
AGSUN 5264	3,11	2,39	3,47	2,44	1,93	2,11	2,34	2,84	2,21	2,94	1,07	1,94	1,93	2,36
AGSUN 5270	3,33	2,19	3,79	3,14	2,48	2,68	2,61	2,90	2,03	2,82	1,31	2,48	2,46	2,63
AGSUN 5272	3,86	3,21	3,91	3,44	1,52	2,23	2,48	2,54	2,27	2,80	1,44	2,47	2,44	2,66
AGSUN 5273	3,76	3,16	3,47	3,32	1,61	2,31	2,67	2,61	1,97	2,81	1,24	2,90	2,22	2,62
AGSUN 5278	2,67	2,48	3,10	2,95	2,30	1,96	2,35	2,80	2,29	3,02	1,51	2,03	2,35	2,45
AGSUN 8251	3,41	2,40	3,49	3,22	2,71	2,05	2,62	2,56	2,35	3,38	1,60	2,17	2,37	2,64
P 65LL02	3,36	2,88	3,16	3,32	1,92	2,27	2,27	2,75	1,95	3,21	1,43	2,18	2,19	2,53
P 65LL14	3,18	2,59	3,05	3,29	2,26	2,42	2,32	2,52	1,89	2,92	0,93	3,30	2,39	2,54
P 65LP54	2,85	2,09	2,94	3,01	2,21	2,07	2,23	2,78	2,12	3,11	1,73	2,87	2,48	2,50
PAN 7080	3,59	2,89	3,91	3,28	1,47	1,94	2,45	2,48	2,06	3,00	1,42	3,19	2,18	2,60
PAN 7095 CL	3,12	1,76	2,16	2,84	3,10	1,91	2,38	2,67	2,09	2,73	1,40	1,97	2,43	2,35
PAN 7098	2,85	2,77	3,52	3,41	2,18	1,45	2,49	3,47	2,21	3,27	1,48	3,07	2,19	2,64
PAN 7100	3,59	2,56	3,19	3,47	1,93	2,12	2,32	3,26	2,07	3,38	1,73	3,46	2,16	2,71
PAN 7102 CLP	3,51	3,03	3,71	3,12	1,61	2,44	2,73	3,04	2,17	3,41	1,46	3,14	2,07	2,73
PAN 7156 CLP	3,40	2,33	2,58	3,36	2,11	2,63	2,56	2,99	2,33	3,16	1,28	3,07	2,35	2,63
PAN 7160 CLP	3,34	2,66	3,29	3,41	2,31	2,59	2,59	2,98	2,20	3,19	1,48	3,40	2,28	2,79
PHB 65A70	3,36	2,17	2,60	2,18	2,22	1,60	2,00	3,04	1,92	2,89	0,94	1,66	2,10	2,21
SV 60064	2,49	2,69	3,09	3,03	1,44	1,66	2,12	2,58	2,04	2,30	1,39	2,27	2,10	2,25
Mean	3,27	2,60	3,25	3,12	2,07	2,14	2,42	2,82	2,12	3,02	1,38	2,64	2,26	2.25
CV	18,4	18,5	15,5	9,9	18,7	16,7	13,0	7,7	10,8	10,3	16,4	18,5	12,7	

♠ Agricol; ▲ ARC-GCI; ● Pannar; ♗ Pioneer, ◘ AGT Foods

Table 8 Oil yield (t ha^{-1}) of cultivars at selected localities 2016/2017

Cultivar	Bethlehem ◘	Boskop ♠ 13/01/2017	Gerdau ♣ 3/01/2017	Ottosdal ♠ 11/01/2017	Potchefstroom ▲ 09-11-2016	Potchefstroom ▲ 08/12/2016	Potchefstroom ▲ 19/01/2017	Senekal ●	Mean
AGSUN 5264	1,1	1,1	1,0	1,0	1,4	1,5	0,4	1,0	1,1
AGSUN 5270	1,0	1,3	1,3	1,2	1,3	1,4	0,5	1,1	1,1
AGSUN 5272	1,4	1,6	1,0	1,0	1,0	1,2	0,5	1,2	1,1
AGSUN 5273	1,3	1,5	1,1	1,1	1,1	1,3	0,4	1,3	1,1
AGSUN 5278	1,2	1,3	0,9	1,0	1,2	1,3	0,7	1,0	1,1
AGSUN 8251	1,1	1,6	0,9	1,1	1,1	1,5	0,6	1,2	1,1
P 65LL02	1,2	1,5	0,9	1,1	1,2	1,6	0,7	1,1	1,2
P 65LL14	1,1	1,6	1,1	1,0	1,2	1,4	0,4	1,5	1,2
P 65LP54	0,9	1,4	1,0	1,0	1,2	1,4	0,7	1,3	1,1
PAN 7080	1,4	1,5	0,8	1,1	1,0	1,4	0,6	1,5	1,2
PAN 7095 CL	0,9	1,3	0,8	1,0	1,2	1,3	0,6	0,9	1,0
PAN 7098	1,2	1,5	0,6	1,1	1,5	1,5	0,6	1,4	1,2
PAN 7100	1,1	1,5	0,9	1,1	1,4	1,6	0,8	1,7	1,3
PAN 7102 CLP	1,3	1,5	1,1	1,2	1,3	1,5	0,6	1,5	1,3
PAN 7156 CLP	1,1	1,5	1,2	1,0	1,3	1,5	0,5	1,5	1,2
PAN 7160 CLP	1,2	1,5	1,1	1,1	1,4	1,6	0,6	1,6	1,3
PHB 65A70	0,9	1,0	0,7	0,9	1,4	1,3	0,4	0,8	0,9
SV 60064	1,2	1,4	0,8	0,9	1,2	1,1	0,7	1,0	1,0
Mean	1,1	1,4	1,0	1,1	1,2	1,4	0,6	1,3	

♠ Agricol; ▲ ARC-GCI; ● Pannar; ♣ Pioneer, ◘ AGT Foods

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
Bainsvlei ● 20/12/2016	3.27	0.35	18.4	3.75	0.04	0.15	0.11
Bethlehem ◘	2.60	0,28	18,50	11,70	0,29	0,16	0,55
Boskop ♠ 14/11/2016	3,25	0,29	15,50	11,60	0,36	0.15	0,63
Boskop ♠ 13/01/2017	3,12	0,18	9,9	9,57	0,48	0,14	0,74
Delmas ● 25/10/2016	2,07	0,22	18.70	18,6	0,50	0,14	0,75
Gerdau ♗ 03/01/2017	2,14	0,21	16,70	13,30	0,39	0,15	0,66
Ottosdal ♠ 11/01/2017	2,42	0,17	13,00	3,00	0,05	0,15	0,14
Potchefstroom ▲ 09/11/2016	2,82	0,13	7,70	8,60	0,55	0,13	0,79
Potchefstroom ▲ 23/11/2016	2,12	0,13	10,80	2,40	0,05	0,15	0,14
Potchefstroom ▲ 08/12/2016	3,02	0,18	10,30	7,10	0,32	0,16	0,59
Potchefstroom ▲19/01/2017	1,38	0,13	16,40	13,40	0,40	0,15	0,67
Senekal ● 15/12/2016	2,64	0,27	18,50	19,15	0,51	0,14	0,76
Ventersdorp ♠ 18/01/2017	2,26	0,17	12,70	Error	-0,04	0,13	-0,13

♠ Agricol; ▲ ARC-GCI; ● Pannar; ♗ Pioneer, ◘ AGT Foods

Table 10 Regression line coordinates at different yield potentials 2016/2017

Cultivar	Yield potential (t ha^{-1})						Average	Intercept	Slope	D-parameter
	1	1.5	2	2.5	3	3.5				
AGSUN 5264	0,80	1,31	1,81	2,32	2,82	3,33	2,36	-0,21	1,01	0,08
AGSUN 5270	1,11	1,61	2,10	2,60	3,09	3,59	2,63	0,12	0,99	0,09
AGSUN 5272	0,72	1,35	1,97	2,60	3,22	3,85	2,66	-0,53	1,25	0,13
AGSUN 5273	0,71	1,33	1,95	2,57	3,19	3,81	2,62	-0,53	1,24	0,08
AGSUN 5278	1,31	1,68	2,04	2,41	2,77	3,14	2,45	0,58	0,73	0,05
AGSUN 8251	1,23	1,69	2,15	2,61	3,07	3,53	2,64	0,31	0,92	0,09
P 65LL02	0,89	1,42	1,95	2,48	3,01	3,54	2,53	-0,17	1,06	0,04
P 65LL14	0,90	1,43	1,96	2,49	3,02	3,55	2,54	-0,16	1,06	0,09
P 65LP54	1,39	1,75	2,11	2,47	2,83	3,19	2,50	0,67	0,72	0,05
PAN 7080	0,59	1,24	1,89	2,54	3,19	3,84	2,60	-0,71	1,30	0,10
PAN 7095 CL	1,54	1,80	2,06	2,32	2,58	2,84	2,35	1,02	0,52	0,21
PAN 7098	0,89	1,46	2,02	2,59	3,15	3,72	2,64	-0,24	1,13	0,12
PAN 7100	0,96	1,53	2,09	2,66	3,22	3,79	2,71	-0,17	1,13	0,09
PAN 7102 CLP	0,84	1,45	2,06	2,67	3,28	3,89	2,73	-0,38	1,22	0,07
PAN 7156 CLP	1,22	1,68	2,13	2,59	3,04	3,50	2,63	0,31	0,91	0,09
PAN 7160 CLP	1,24	1,74	2,24	2,74	3,24	3,74	2,79	0,24	1,00	0,06
PHB 65A70	0,75	1,23	1,70	2,18	2,65	3,13	2,21	-0,20	0,95	0,16
SV 60064	0,94	1,37	1,79	2,22	2,64	3,07	2,25	0,09	0,85	0,08

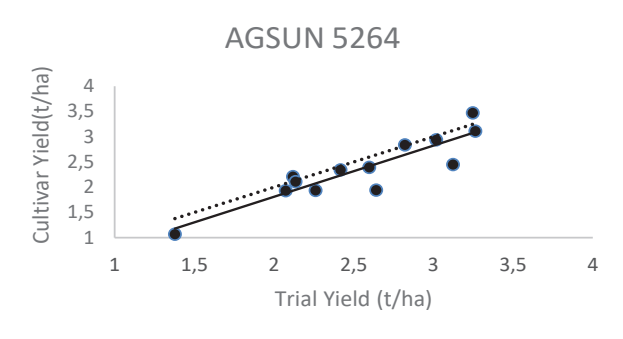
Table 11 Yield probability (%) of cultivars 2016/2017 at different yield potentials

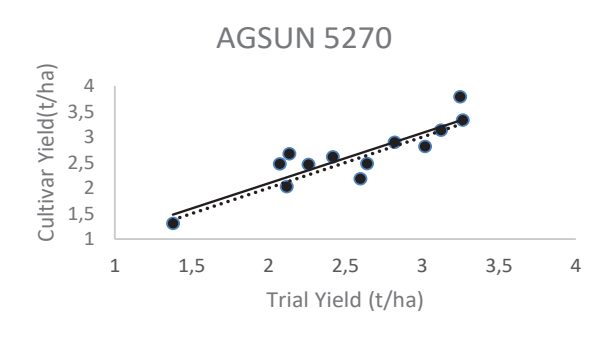
Cultivar	Yield potential (t ha^{-1})					
	1	1.5	2	2.5	3	3.5
AGSUN 5264	30	28	27	27	28	30
AGSUN 5270	61	62	62	63	61	60
AGSUN 5272	27	36	47	61	72	80
AGSUN 5273	22	30	43	59	74	83
AGSUN 5278	85	75	57	35	17	8
AGSUN 8251	72	71	68	64	59	53
P 65LL02	34	37	41	46	52	57
P 65LL14	40	42	45	49	53	56
P 65LP54	92	84	68	45	23	10
PAN 7080	16	24	37	55	71	82
PAN 7095 CL	81	71	55	35	20	11
PAN 7098	41	46	52	60	66	71
PAN 7100	46	53	61	70	76	80
PAN 7102 CLP	32	44	58	73	84	90
PAN 7156 CLP	71	69	65	61	55	50
PAN 7160 CLP	78	81	83	84	83	81
PHB 65A70	32	28	24	22	21	21
SV 60064	43	34	24	17	11	9

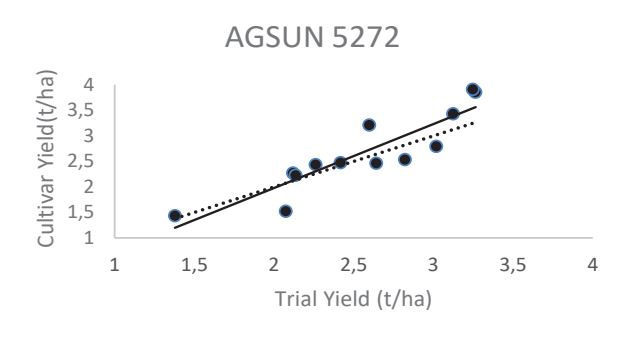
Table 12 Yield probability (%) of cultivars 2015/2016 and 2016/2017 at different yield potentials

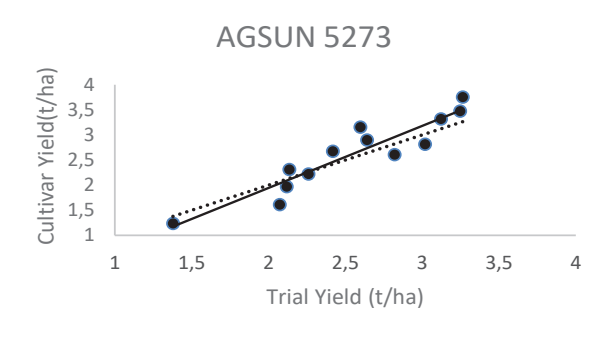
Cultivar	Yield potential (t ha^{-1})					
	1	1.5	2	2.5	3	3.5
AGSUN 5264	36	29	23	18	14	11
AGSUN 5270	50	53	55	58	60	63
AGSUN 5272	35	42	50	59	66	73
AGSUN 5273	25	34	43	55	65	74
AGSUN 5278	62	52	43	33	25	19
AGSUN 8251	56	56	55	55	53	53
P 65LL02	58	58	56	56	54	54
P 65LL14	56	57	55	55	54	54
PAN 7080	42	50	58	66	73	78
PAN 7095 CL	68	59	49	39	30	22
PAN 7098	56	58	58	59	59	60
PAN 7100	50	53	56	59	61	64
PAN 7102 CLP	45	53	62	70	77	82
PAN 7160 CLP	65	70	75	79	82	85
PHB 65A70	44	38	32	27	22	19

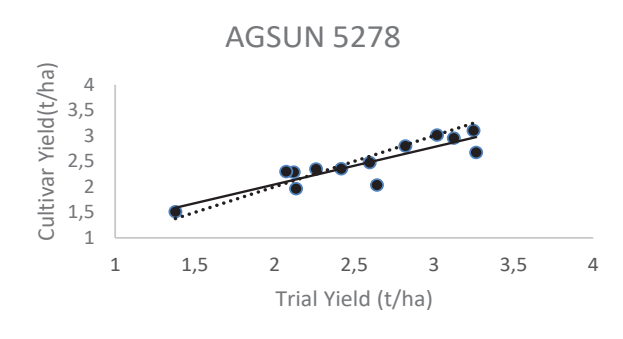
Figure 1 Regression lines for cultivars 2016/2017

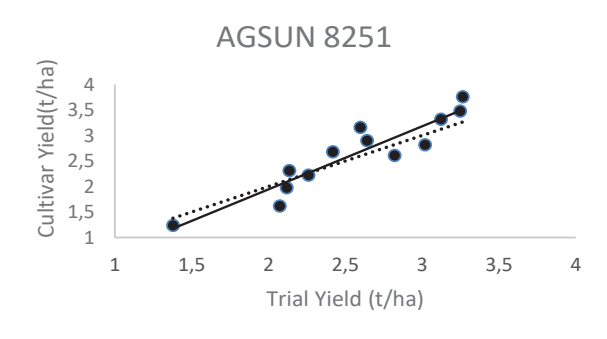


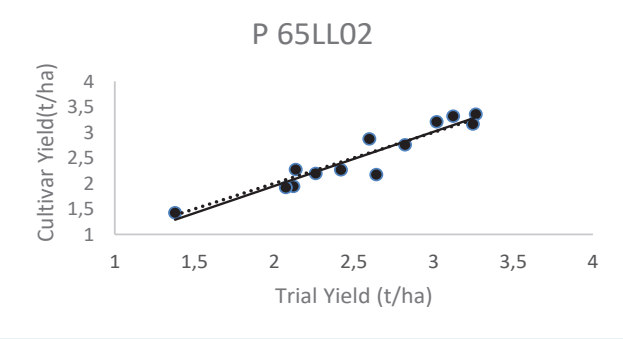


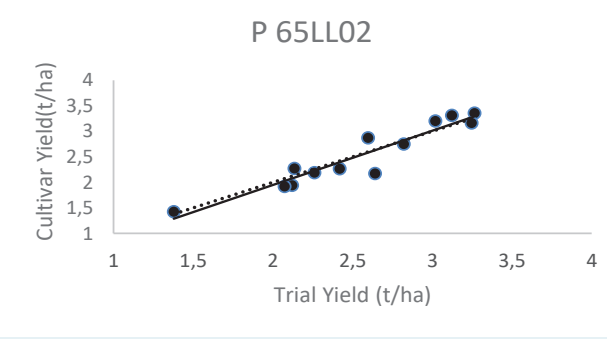












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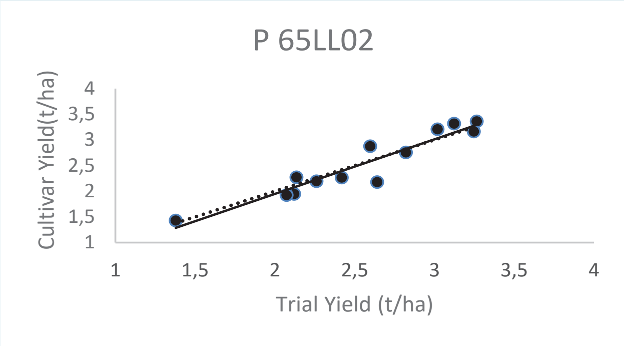
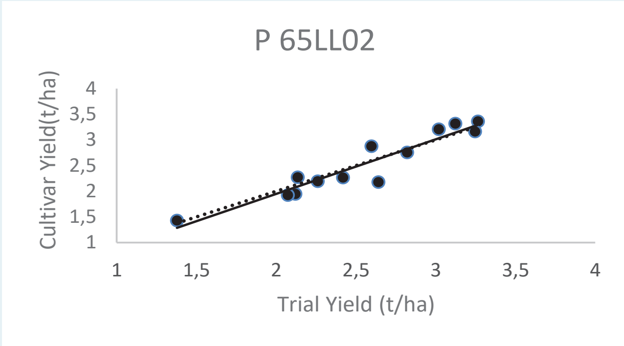
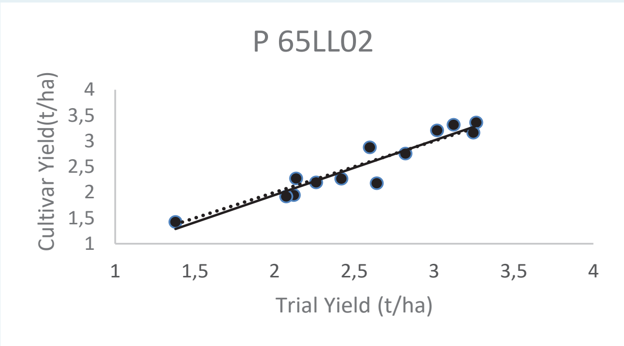
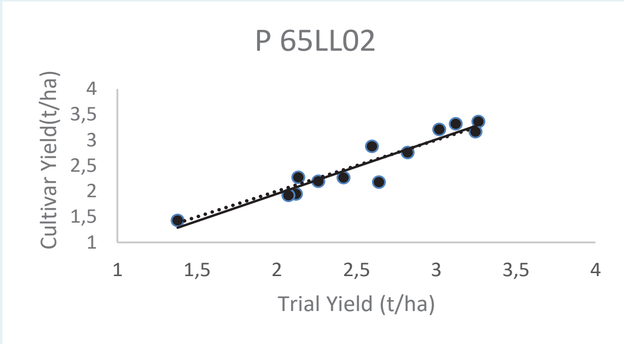

P 65LL02
Cultivar Yield(t/ha)
4
3,5
3
2,5
2
1,5
1
1
1,5
2
2,5
3
3,5
4
Trial Yield (t/ha)


P 65LL02
Cultivar Yield(t/ha)
4
3,5
3
2,5
2
1,5
1
1
1,5
2
2,5
3
3,5
4
Trial Yield (t/ha)


P 65LL02
Cultivar Yield(t/ha)
4
3,5
3
2,5
2
1,5
1
1
1,5
2
2,5
3
3,5
4
Trial Yield (t/ha)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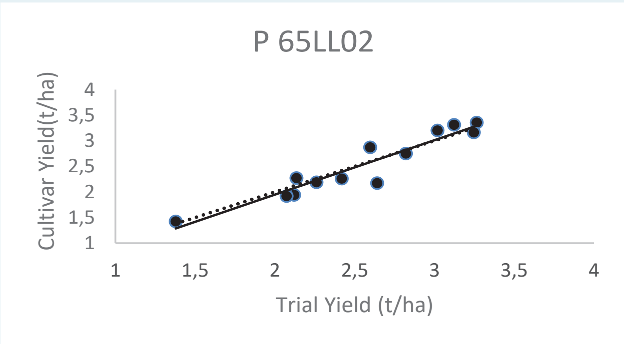
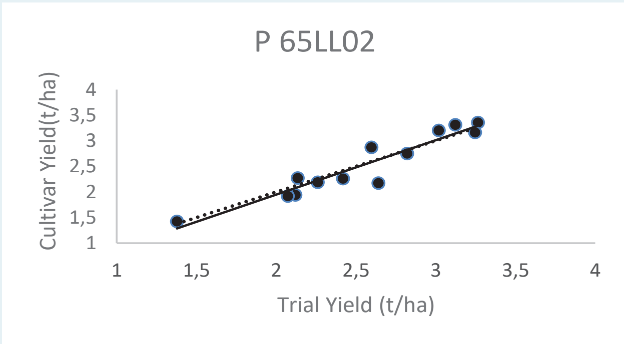
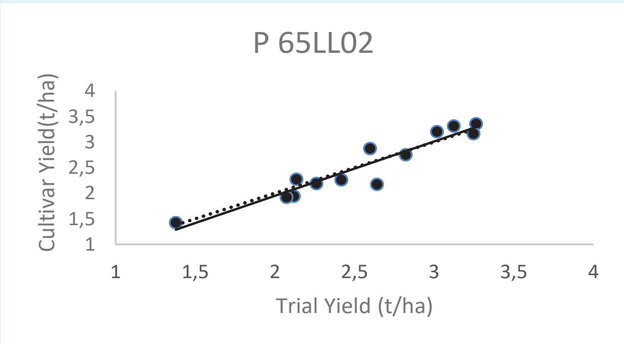
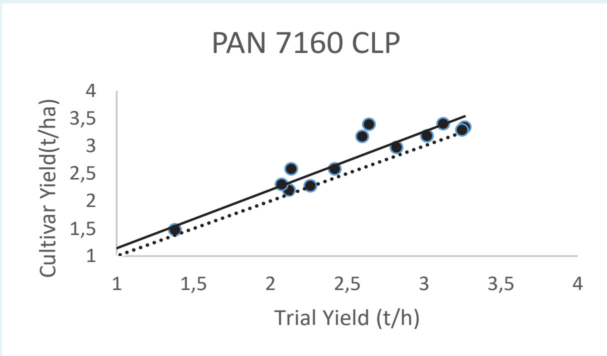
Cultivar Yield(t/ha)
4
3,5
3
2,5
2
1,5
1
1
1,5
2
2,5
3
3,5
4
Trial Yield (t/ha)

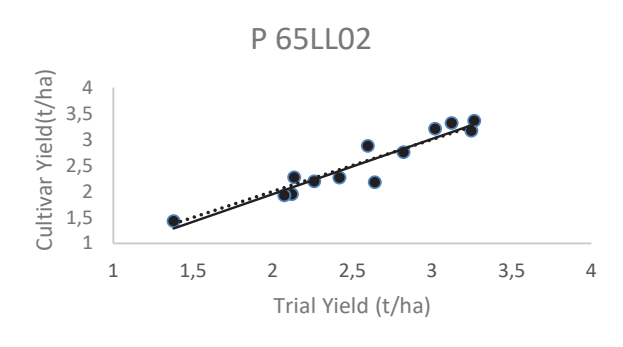

P 65LL02
Cultivar Yield(t/ha)
4
3,5
3
2,5
2
1,5
1
1
1,5
2
2,5
3
3,5
4
Trial Yield (t/ha)


P 65LL02
Cultivar Yield(t/ha)
4
3,5
3
2,5
2
1,5
1
1
1,5
2
2,5
3
3,5
4
Trial Yield (t/ha)


P 65LL02
Cultivar Yield(t/ha)
4
3,5
3
2,5
2
1,5
1
1
1,5
2
2,5
3
3,5
4
Trial Yield (t/ha)


PAN 7160 CLP
Cultivar Yield(t/ha)
4
3,5
3
2,5
2
1,5
1
1
1,5
2
2,5
3
3,5
4
Trial Yield (t/h)

18



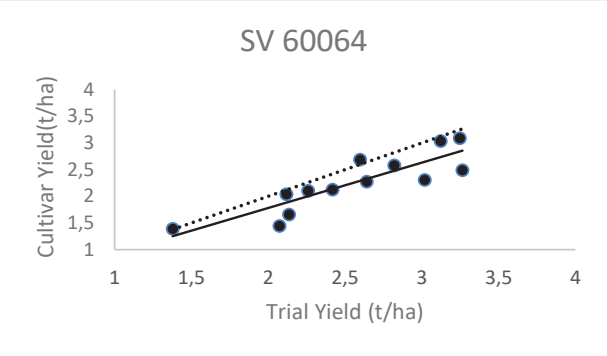
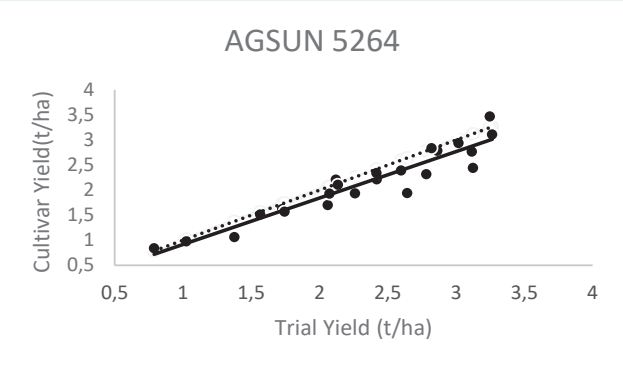
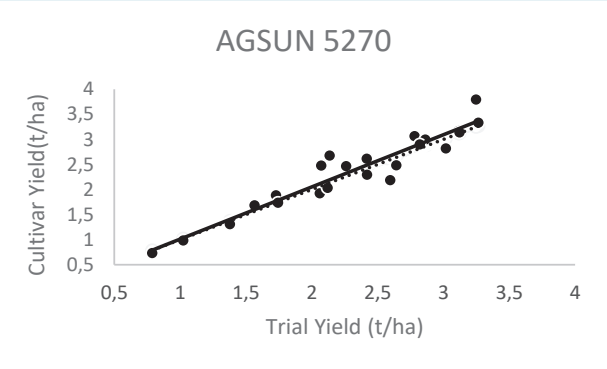
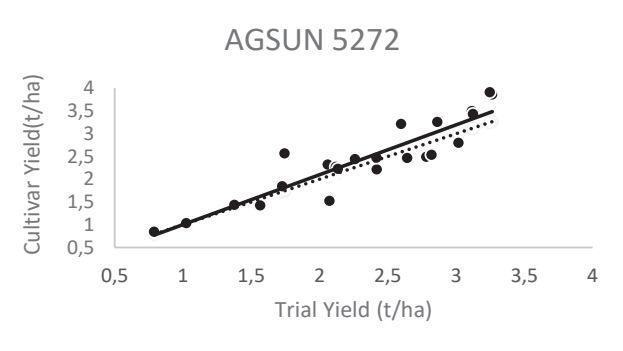
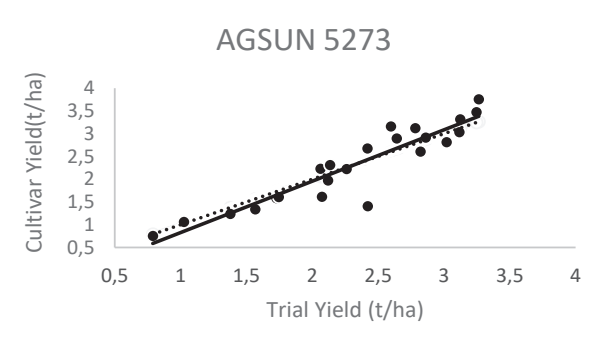


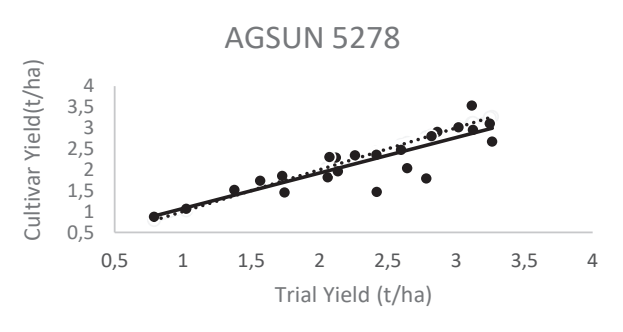
Figure 2 Regression lines for cultivars 2015/2016 and 2016/2017

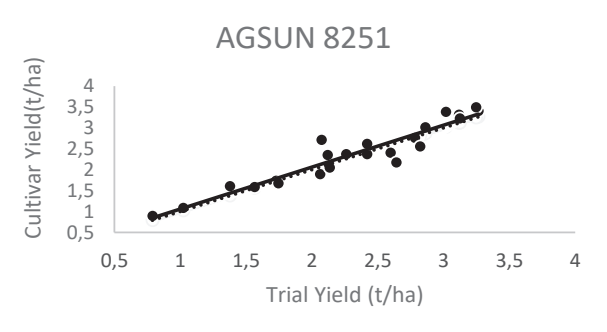


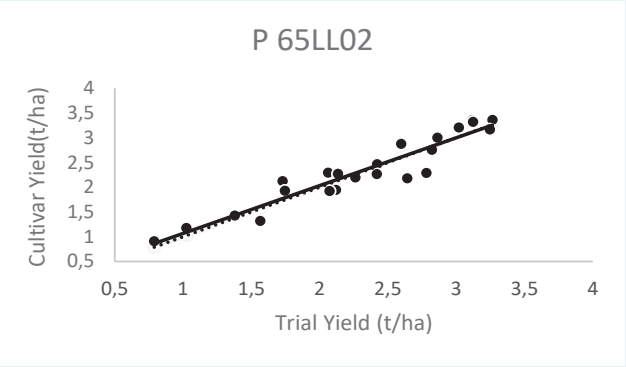


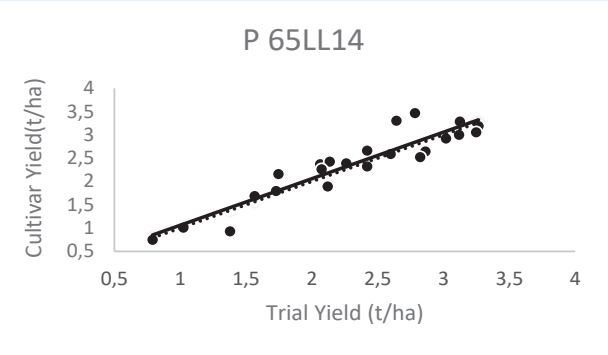


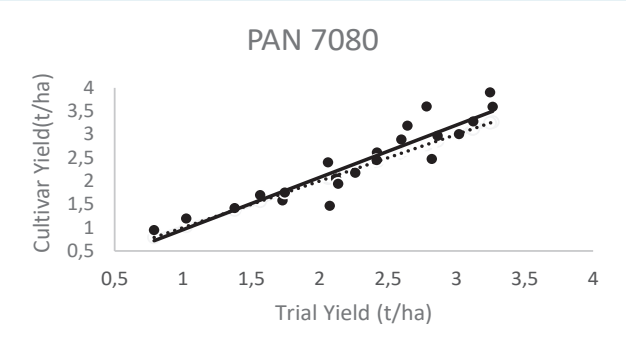


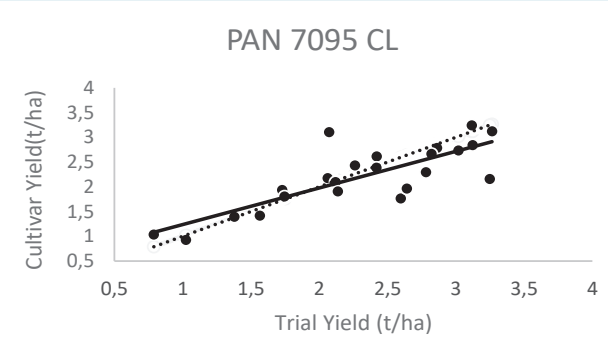


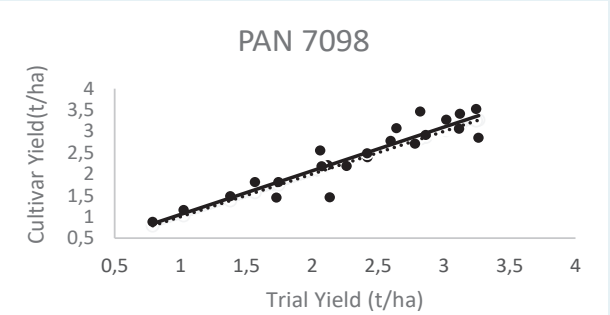


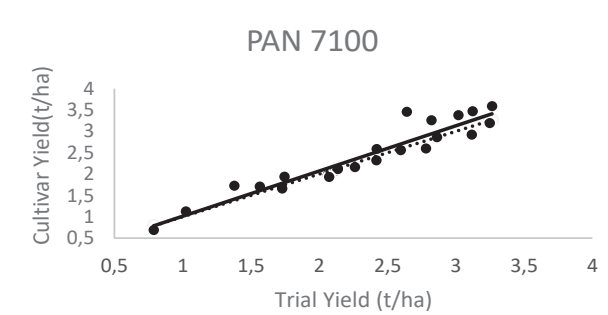

P 65LL02
Cultivar Yield(t/ha)
Trial Yield (t/ha)

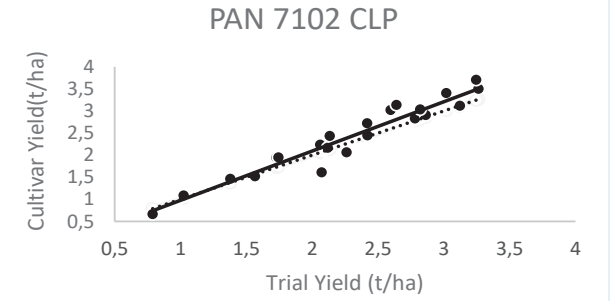

P 65LL14
Cultivar Yield(t/ha)
Trial Yield (t/ha)

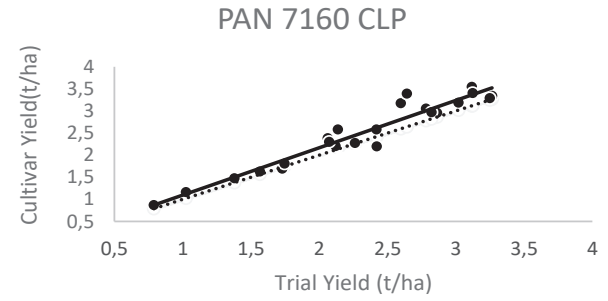

PAN 7080
Cultivar Yield(t/ha)
Trial Yield (t/ha)


PAN 7095 CL
Cultivar Yield(t/ha)
Trial Yield (t/ha)


PAN 7098
Cultivar Yield(t/ha)
Trial Yield (t/ha)


PAN 7100
Cultivar Yield(t/ha)
Trial Yield (t/ha)


PAN 7102 CLP
Cultivar Yield(t/ha)
Trial Yield (t/ha)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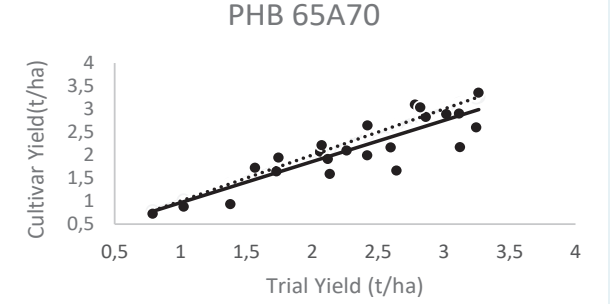
Cultivar Yield(t/ha)
Trial Yield (t/ha)


PHB 65A70
Cultivar Yield(t/ha)
Trial Yield (t/ha)