Evaluation of sunflower cultivars:
2013/2014 season

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

INTRODUCTION

Optimisation of processes in any industry is key to their successes. Sunflower cultivar trials, which are done since the early 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 all the important cultivars in the main areas of production. The information generated in 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 2013/2014 season with the voluntary collaboration of Agricol, Capstone, Pannar, Pioneer and Syngenta. Seed companies entered 20 cultivars for evaluation (Table 1) and supplied seed to the ARC-GCI which planned field trials with randomised complete-block design layouts with three replicates. Germination tests, according to ISTA rules, were done on the supplied seed. 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 20 cultivars were Clearfield types on which use of the post emergence broad leaf weed controlling herbicide imazamox herbicide, is possible. These cultivars was treated in the same way as the regular cultivars and received no imazamox herbicide.

Each collaborating seed company had to conduct at least one trial for each cultivar entry. Four trials were done by the ARC-GCI, six by Agricol, one by Capstone, ten by Pannar, two by Pioneer and two by Syngenta. Trial sites were selected by collaborators and the people involved are listed in Table 2. Planting dates, amount of fertiliser applied, soil analyses and other agronomic details from some field trials are reported in Table 3. Grain yields were recorded on all trials while the period from planting to 50% flowering was recorded on selected trials only.

Yield data and seed samples were send to ARC-GCI for analyses. The seed were analysed by a service provider using the Near Infrared Spectroscopy method. Yield data from all field trials were subjected to analyses of variance and the regression line technique as described by Loubser and Grimbeek (1984) was used to calculate yield probabilities for cultivars at different yield potentials. Six of the 25 trials failed due poor crop establishment or, were rejected due to coefficients of variation exceeding 20%. This report contains results of successful trials only.

RESULTS

Days from planting to flowering

The mean number of days from planting to 50% flowering of cultivars ranged from 58 to 75 days (Table 4). Calculated across cultivars and localities, this period was 67 days. Among cultivars, SY 4045 had the shortest period 62 days and CAP 4000 the longest period from planting to flowering at 69 days.

Oil and protein concentration

The moisture free oil and protein concentrations of the seed 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 31 to 53% 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 39%.

The highest mean oil concentration among localities was at Potchefstroom (planting date 3rd November 2013) with 48%. The locality with the lowest mean oil content of 39% was again Potchefstroom at the relative late planting date of 20 January 2014. The highest oil concentration among cultivars and calculated across localities, was found to be Agsun 5264 at 47%.

The protein content varied from 10 to 22% among cultivars at the different localities. Among localities, Potchefstroom had both the mean highest and lowest protein contents of 20 and 11 % for 3 November 2013 and 20 January 2014, respectively. Calculated across localities, Agsun 5264 had the highest protein content (18%) and PAN 7049 the lowest (16%).

Seed yield

The mean seed yield of cultivars at the respective localities is presented in Table 7. The highest trial mean yield of 3.66 t ha^{-1} was obtained at Boskop planted on 4th January 2014 and the lowest of 1.20 t ha^{-1}, at Settlers.

The six best performing cultivars, in terms of average yield calculated over localities, were PAN 7080, PAN 7049, PAN 7098, PAN 7100, AGSUN 5270, and AGSUN 8251. The overall mean yield for 2013/2014 was 2.41 t ha^{-1}, about 14% higher than that of the 2012/2013 season.

No high oleic cultivar was entered for evaluation in 2013/14. Three Clearfield cultivars, PAN 7095CL, PAN 7101CL and PAN 7102CLP were entered. The mean yield of PAN 7095CL was 3% higher and the mean yield of PAN 7101CL and PAN 7102CLP about 4% lower, than the overall mean yield.

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 of importance to farmers who are compensated for seed oil concentration.

The oil yield for cultivars at the various localities varied from 0.47 to 1.90 t ha^{-1} with an overall mean of 1.11 t ha^{-1}. The locality with the highest mean oil yield was Boskop at 1.58 t ha^{-1}. The cultivar with the highest mean oil yield was AGSUN 5270 with 1.21 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 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 regression lines for 2014/14 are shown in Figure 1 and for cultivars evaluated in 2012/13 and 2013/14 in Figure 2.

The yield stability of cultivars varied nearly nine fold among cultivars. Cultivars which had exceptionally high stabilities (D-parameter ≤ 0.03) were, AGSUN 8251, PAN 7033, PAN 7100, PAN 7102CLP AND SY 4200.

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 20 cultivars for 2013/14 are shown in Table 11. It takes account of both the the cultivar X environment interaction and the yield stability and is therefore a reliable measure for cultivar choice. Yield probabilities higher than 50% are shown in bold print in Table 11 and indicates which cultivars would be a sensible choice at the various yield potentials.

The yield probabilities of 14 cultivars evaluated in 34 trials in 2012/13 and 2013/14, are shown in Table 12. Tables 11 and 12 should be used jointly for cultivar selection.

Acknowledgements

Funding from the Oil and Protein Seed Development Trust is 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 germination rate and supplier company 2013/2014

Cultivar	Germinated (%)*			Company
	Normal	Abnormal	Dormant/dead	
Agsun 5264	91	7	2	Agricol ♠
Agsun 5270	97	3	0	
Agsun 5271	87	11	2	
Agsun 5278	96	4	0	
Agsun 5279	93	6	1	
Agsun 8251	97	2	1	
CAP 4000	93	5	2	Capstone ♦
PAN 7033	96	3	1	Pannar ●
PAN 7049	95	4	1	
PAN 7057	95	4	1	
PAN 7080	98	2	0	
PAN 7098	99	1	0	
PAN 71D0	96	3	1	
PAN 7095CL	97	1	2	
PAN 71D1CL	89	4	7	
PAN 71D2CLP	97	2	1	
PHB 65A25	94	3	3	Pioneer ø
PHB 65A70	94	5	1	
SY4200	98	1	1	Syngenta ¤
SY4045	89	7	4	

* According to ISTA rules

Table 2 **Collaborating company, trial localities and responsible co-workers 2013/2014**

Company	Localities	Planting dates	Co-workers	Address of co-workers
Agricol ■	Boskop	04/01/2014	J Swanepoel	PO Box 6645, Baillie Park, 2526
	Kroonstad	14/12/2013		
	Ottosdal	13/12/2013		
	Wesselsbron	27/11/2013		
	Viljoenskroon	20/12/2013		
ARC-GCI ▲	Potchefstroom	03/11/2013	W Deale	P/Bag X1251, Potchefstroom, 2520
		06/12/2013		
		09/01/2014		
		20/01/2014		
Capstone ♦	Bethlehem	31/12/2013	G Willemse	P O Box 302, Howick, 3290.
PANNAR ●	Bainsvlei	20/11/2013	L Schoonraad/ R Lochner	PO Box 439, Delmas, 2210
	Delmas	06/11/2013		
	Lichtenburg	09/01/2014		
	Senekal	20/12/2013		
	Settlers x 2	16/01/2014		
	Wesselsbron	11/12/2013		
Pioneer ◆	Gerdau	13/12/2013	P Fourie	Outspan House, OR Tambo 64, Potchefstroom, 2531
Syngenta ■	Settlers	09/01//2014	F van Deventer	Private Bag X60, Halfway House, 1685

Table 3 Trial site information 2013/2014

Locality	Planting date	Plant population	Soil classification	Top soil analysis (mg kg^{-1})					Fertiliser applied (Kg ha^{-1})	Row width (cm)	Weed- and Insecticides	Nett plot size (m^2)
				pH (KCl)	P	K	Ca	Mg				
Balmoral ●	05/11/13	40 000	Balmoral	4.3	12.6	166.3	343	131	N 4, P 2, K 1	91	Mechanical	16.38
Bethlehem ♦	31/12/13	42 000	–	-	-	-	-	-	–	91	-	12.74
Bosloop ▲	04/01/14	-	–	-	-	-	-	-	–	–	-	-
Delmas ●	05/11/13											
Geelau ■	13/12/13											
Kroonstad ●	14/12/13	40 000	Avalon	5	20	120	300	15	21 calcific lime	91	Atrazine, Racer, Gallant, Alfacide	13.65
Lichtenburg ♦	14/12/13	35 000	–	5	15	-	-	-	N 45; P 10; K 0	91	S-Metolachlor, mechanical	9.1
Olivedal ▲												
Potchefstroom ▲	13/11/13	35 000	Westleigh	6.06	31	233	855	345	N 44; P 8; K 4	90	Atrazex 480 CS	14.4
Potchefstroom ▲	5/12/13	35 000	Westleigh	6.38	25	126	1050	463	N 44; P 8; K 4	90	Atrazex 480 CS	14.4
Potchefstroom ▲	09/01/14	35 000	Avalon	5.98	33	125	893	375	N 44; P 8; K 4	90	Atrazex 480 CS	14.4
Potchefstroom ▲	20/1/14	35 000	Avalon	6.17	37	275	1005	413	N 44; P 8; K 4	90	Atrazex 480 CS	14.4
Senekal ●												
Sellers ■	09/01/14	28 500	Avalon	5.1	1.21	208.9	2513	503.2	–	100	-	14
Sellers ●	16/01/14	40 000	Avalon	5.9	3	300	6010	1160	70 kg MAP	91	Metolachlor	13.65
Sellers ●	16/01/14	40 000	Avalon	5.9	3	300	6010	1160	70 kg MAP	91	Metolachlor	13.65
Wesselsbron ▲	27/11/13											
Wesselsbron ●	11/12/13	40 000	–	-	-	-	-	-	N 62; P 13; K 0 + 1.5 t dolomitic lime	91	Gallant Mebagan, Karate	16.63
Wilgenbosch ▲	20/12/13	-		-	-	-	-	-	–	–	-	-

* ● Agricol; ▲ ARC-GCI; ♦ Capstone; ● Pannar; ♦ Pioneer; ■ Syngenta

Table 4 Number of days from planting to 50 percent flowering of cultivars at selected localities and planting dates 2013/2014

Cultivar	Locality and planting date												Mean
	Boskop 16/12/2013♣	Boskop 04/01/2014 ♣	Gerdau 13/12/2013 ●	Kroonstad 14/12/2013 ♣	Lichtenburg 14/12/2013 ●	Ottosdal 13/12/2013 ♣	Potchefstroom 13-11-2013 ▲	Potchefstroom 06/12/13 ▲	Potchefstroom 09/01/2014 ▲	Potchefstroom 20/01/2014 ▲	Viljoenskroon 20/12/2013 ♣	Wesselsbron 27/11/2013 ♣	
AGSUN 5264	65	64	69	64	66	66	68	67	68	70	60	63	66
AGSUN 5270	68	62	73	67	70	67	69	68	67	69	63	64	67
AGSUN 5271	68	63	74	67	70	68	69	70	67	70	63	64	68
AGSUN 5278	68	65	69	64	67	66	68	67	74	74	62	64	67
AGSUN 5279	65	62	74	68	71	67	69	68	67	69	62	64	67
AGSUN 8251	68	64	69	64	66	67	67	68	73	73	62	64	67
CAP 4000	68	64	75	68	71	68	69	71	72	74	63	64	69
PAN 7033	65	64	73	68	69	68	69	67	73	74	62	65	68
PAN 7049	68	64	71	67	69	67	68	68	71	72	62	64	67
PAN 7057	68	63	72	67	70	67	68	67	72	72	62	64	68
PAN 7080	68	64	72	67	70	67	68	70	72	74	62	68	68
PAN 7098	65	64	73	68	70	66	68	71	74	71	62	65	68
PAN 7100	65	63	70	67	69	67	68	68	71	72	62	63	67
PAN 7095CL	68	62	73	64	69	67	68	70	71	71	63	68	67
PAN 7101CL	68	64	75	68	71	68	69	72	72	69	63	68	68
PAN 7102CLP	64	62	67	68	67	66	68	64	67	71	61	63	65
PHB 65A25	68	65	73	64	69	67	68	71	75	71	63	65	68
PHB 65A70	64	61	69	65	67	65	68	67	68	71	62	63	66
SY 4200	65	62	74	68	70	67	69	69	75	75	62	65	68
SY 4045	63	60	63	62	63	61	62	64	64	64	58	63	62
Mean	66	63	71	66	69	67	68	68	71	71	62	64	

♣ Agricol; ▲ ARC-GCI; ♦ Capstone;; ● Pannar; ≠ Pioneer; ■ Syngenta.

Table 5 The moisture free seed oil concentration (%) of cultivars at selected localities 2013/2014

Cultivar	Locality												
	Bainsvlei 20/11/2013 ●	Boskop 04/01/2014 ♦	Delmas 06/11/2013 ●	Kroonstad 14/12/2013 ♦	Lichtenburg 09/01/2014 ●	Ottosdal 13/12/2013 ♦	Potchefstroom 3/11/2013 ▲	Potchefstroom 20/1/2014 ▲	Senekal 20/12/2013 ●	Settlers 16/01/2014 ●	Wesselsbron 11/12/2013 ●	Viljoenskroon 20/12/2013 ♦	Mean
Agsun 5264	49.1	47.3	45.7	48.0	41.3	47.3	48.8	45.0	49.3	43.3	48.4	46.8	46.5
Agsun 5270	39.5	44.8	44.0	45.7	42.5	42.9	44.7	40.3	46.4	40.7	44.2	44.5	43.4
Agsun 5271	45.0	43.8	42.7	41.0	40.4	39.0	48.5	36.1		38.9	41.5	43.4	41.8
Agsun 5278	42.5	40.4	40.9	42.3	38.0	40.6	48.6	40.7	43.5	38.9	38.4	41.3	41.3
Agsun 5279	45.8	44.0	42.1	41.0	41.3	41.4	43.1	38.7	44.4	42.6	39.2	41.4	42.1
Agsun 8251	51.1	41.0	42.7	43.4	39.7	36.9	46.1	30.9	44.6	39.9	40.3	42.0	41.6
CAP 4000	42.5	41.3	42.1	39.5	38.7	40.5	48.0	43.1	43.5	40.0	37.3	40.0	41.4
PAN 7033	45.0	42.8	42.3	40.0	38.6	39.6	46.5	36.9	40.9	36.7	37.4	41.9	40.7
PAN 7049	44.4	42.6	42.9	40.2	38.8	41.2	52.9	40.2	43.3	40.9	40.6	41.9	42.5
PAN 7057	34.7	43.9	43.4	41.0	40.2	41.7	50.4	37.7	45.4	38.9	40.4	42.3	41.7
PAN 7080	48.1	42.2	42.1	41.8	38.2	41.8	51.6	38.1	41.7	38.5	40.9	41.8	42.2
PAN 7096	43.7	46.4	42.3	39.7	39.0	41.2	49.6	37.5	41.6	38.5	39.9	39.5	41.6
PAN 7100	46.6	40.3	44.6	43.0	41.7	44.3	47.3	38.3	47.6	41.8	39.4	44.1	43.3
PAN 7105CL	44.1	43.4	42.1	39.8	39.3	41.0	45.3	37.6	43.9	39.5	38.8	42.8	41.5
PAN 7101CL	41.9	42.0	40.8	39.7	37.1	39.7	40.6	37.7	41.6	33.9	38.8	42.2	39.7
PAN 7102CLP	44.9	36.5	43.2	44.1	39.3	42.8	44.8	38.1	45.8	38.7	42.0	43.9	42.0
PHB 65A25	43.2	46.4	44.0	44.0	42.5	46.3	49.5	41.6	49.4	45.1	46.7	46.4	45.4
PHB 65A70	43.7	41.4	43.5	43.5	40.0	40.3	46.2	40.9	43.8	41.4	43.9	41.9	42.5
SY4200	51.4	50.1	43.5	43.5	41.3	43.1	52.9	38.3		44.8	43.8	44.8	45.2
SY4045	47.1	41.2	43.5	43.5	40.0	41.2	47.2	39.2	45.5	41.4	39.5	41.2	42.5
Mean	44.72	43.09	42.92	42.24	39.9	41.84	47.83	38.85	45.5	40.21	40.97	42.71	42.4

* ♠ Agtest; ▲ ARC-GCI; ♦ Capstone; ● Pannar; ■ Pioneer; ■ Syngenta.

Table 6 The moisture free seed protein concentration (%) of cultivars at selected localities 2013/2014

Cultivar	Locality												
	Bainsvlei 20/11/2013 ♦	Boskop 04/01/2014 ♦	Delmas 06/11/2013 ♦	Kroonstad 14/12/2013 ♦	Lichtenburg 09/01/2014 ♦	Ottosdal 13/12/2013 ♦	Potchefstroom 3/11/2013 ▲	Potchefstroom 20/1/2014 ▲	Senekal 20/12/2013 ♦	Settlers 16/01/2014 ♦	Wesselsbron 11/12/2013 ♦	Viljoenskroon 20/12/2013 ♦	Mean
Agsun 5264	18.6	19.3	18.8	16.9	19.6	16.9	10.4	21.9	16.1	17.6	19.9	17.8	17.8
Agsun 5270	17.1	17.8	17.6	13.9	18.2	16.6	10.7	20.2	14.4	17.0	16.7	16.9	16.4
Agsun 5271	16.1	17.5	17.2	17.3	20.0	16.5	10.4	21.0		17.6	16.9	16.8	17.2
Agsun 5278	17.4	18.4	17.5	16.9	20.1	16.0	10.6	21.0	14.8	16.2	16.8	17.6	17.1
Agsun 5279	19.2	17.7	17.6	17.7	18.4	15.0	10.9	18.9	15.1	17.8	16.7	17.2	17.0
Agsun 8251	17.2	17.8	16.0	13.9	19.4	16.1	10.0	22.3	14.1	16.3	16.5	17.2	16.9
CAP 4000	19.8	18.7	17.4	16.9	20.2	15.7	10.1	20.8	15.9	17.0	20.3	17.8	17.5
PAN 7033	17.4	17.3	17.5	16.3	20.0	14.8	10.6	21.0	14.0	16.8	16.8	17.4	16.8
PAN 7049	16.8	16.9	17.0	14.3	19.8	14.5	12.2	20.1	12.6	17.3	16.8	16.2	16.2
PAN 7057	17.7	16.6	17.3	16.5	18.9	15.1	11.5	20.1	13.4	16.7	17.2	16.5	16.5
PAN 7080	17.1	18.8	17.8	14.6	20.8	15.4	11.0	19.9	14.8	17.5	16.7	16.3	16.7
PAN 7098	17.5	16.0	16.9	15.7	18.5	14.6	11.8	20.2	13.5	16.9	16.8	17.2	16.3
PAN 7100	17.9	17.3	17.5	15.2	20.4	15.1	11.0	19.8	13.5	17.6	16.7	16.9	16.7
PAN 7095CL	18.9	19.0	17.0	17.3	20.3	16.0	11.3	19.5	14.4	16.2	17.3	17.4	17.1
PAN 7101CL	17.8	17.7	17.5	15.3	20.8	15.2	10.9	20.7	15.7	16.5	17.4	16.4	16.8
PAN 7102CLP	18.0	16.9	17.9	14.0	18.0	16.7	11.3	19.6	13.8	16.5	17.4	16.3	16.5
PHB 65A25	19.3	17.0	19.0	15.4	21.0	16.6	11.2	19.2	14.1	16.6	16.3	16.1	17.1
PHB 65A70	17.2	19.1	17.7	16.2	19.2	17.3	10.5	18.4	14.9	16.1	16.7	16.9	16.7
SY4200	18.0	16.3	19.8	17.0	22.3	15.8	11.3	19.9		16.4	16.9	17.4	17.5
SY4045	16.9	21.1	16.9	14.8	21.4	15.7	12.7	18.7	14.7	16.3	20.3	16.2	17.3
Mean	17.9	17.9	17.8	15.8	19.8	16.0	11.0	20.2	14.4	16.8	16.1	17.0	

* ♦ Agricol; ▲ ARC-GCI; ♦ Capstone; ● Pannar; ■ Pioneer; ■ Syngenta.

Table 7 Mean seed yield (t ha^{-1}) of cultivars at each locality 2013/2014

Cultivar	Locality																		
	Bainsvlei 20/11/2013 ●	Bethlehem 31/12/2013 ◆	Boskop 04/01/2014 ✚	Delmas 06/11/2013 ●	Gerdau 13/12/2013 ■	Kroonstad 14/12/2013 ✚	Lichtenburg 09/01/2014 ●	Ottosdal 13/12/2013 ✚	Potchefstroom 3/11/2013 ▲	Potchefstroom 06/12/2013 ▲	Potchefstroom 09/01/2014 ▲	Potchefstroom 20/1/2014 ▲	Senekal 20/12/2013 ●	Settlers 09/01//2014 ■	Settlers 16/01/2014 ●	Settlers 16/01/2014 ●	Wesselsbron 27/11/2013 ✚	Wesselsbron 11/12/2013 ●	Viljoenskroon 20/12/2013 ✚	Mean
Agsun 5264	2.15	1.45	3.31	2.71	2.91	2.45	1.83	2.23	1.97	2.27	1.93	1.78	1.86	1.66	1.45	1.67	2.52	3.55	3.61	2.27
Agsun 5270	3.02	1.07	3.99	2.47	2.42	2.48	2.40	3.47	2.28	1.77	2.12	1.75	2.09	1.76	2.08	1.87	2.94	3.66	4.06	2.51
Agsun 5271	3.00	1.10	3.87	2.39	2.47	2.71	2.26	3.20	1.93	2.04	2.14	1.88	2.00	1.85	1.57	1.81	2.96	3.83	3.70	2.46
Agsun 5278	2.50	1.16	3.83	3.01	2.91	2.51	2.44	3.25	1.66	1.65	2.16	1.59	2.09	1.66	1.95	1.85	2.54	3.14	3.66	2.42
Agsun 5279	2.91	1.24	4.06	2.50	2.12	2.52	2.03	3.07	1.78	2.03	2.20	1.89	2.47	1.79	2.01	1.81	2.66	3.34	3.97	2.43
Agsun 5251	2.77	1.21	3.88	2.97	3.02	2.62	2.39	2.86	1.81	2.06	2.16	1.56	1.82	1.73	2.03	1.85	2.68	3.93	3.92	2.50
CAP 4000	2.66	1.16	3.17	2.57	2.89	2.15	2.05	2.52	1.88	2.04	1.96	1.71	2.42	1.71	1.95	1.89	2.43	3.79	3.73	2.35
PAN 7033	2.66	1.37	3.72	2.29	2.69	2.67	2.09	2.68	2.05	1.82	2.19	1.45	2.01	1.82	1.90	2.00	2.69	3.32	3.83	2.38
PAN 7049	3.23	1.36	3.91	2.95	2.54	2.56	1.89	2.96	2.25	2.07	2.30	1.76	2.17	2.11	2.23	2.37	2.67	3.56	3.61	2.56
PAN 7057	2.57	1.17	3.85	2.65	2.53	2.50	1.94	3.15	2.21	2.15	1.94	1.96	2.10	1.75	2.21	2.19	2.44	2.68	4.00	2.42
PAN 7060	3.21	1.34	3.87	2.74	3.55	2.49	2.40	3.13	1.97	2.06	2.16	1.65	2.94	1.91	1.57	1.80	2.95	3.50	4.11	2.61
PAN 7066	2.70	1.20	4.10	3.17	2.42	2.60	1.89	3.36	1.99	2.03	2.01	1.78	1.99	1.79	2.31	1.95	3.13	3.88	3.98	2.54
PAN 7100	2.59	1.42	3.90	2.93	2.70	2.51	2.37	3.21	2.11	2.08	2.27	1.91	2.56	1.80	2.03	2.09	2.82	3.16	3.58	2.53
PAN 7065CL	3.25	1.13	3.52	3.41	3.09	2.47	2.12	2.57	1.98	2.04	1.90	1.65	2.87	1.67	1.79	1.99	2.39	3.72	3.73	2.49
PAN 7101CL	3.38	1.13	3.56	2.73	3.05	2.43	1.77	2.39	1.80	1.98	1.77	1.55	2.19	1.39	1.33	1.69	2.78	2.94	3.16	2.26
PAN 7102CLP	2.34	1.36	3.42	2.66	2.89	2.26	2.26	2.59	2.06	2.14	2.16	1.89	2.01	1.89	1.66	1.94	2.36	3.09	3.65	2.35
PHB 65A25	2.83	0.95	3.35	2.24	3.14	2.28	2.58	2.15	1.65	2.15	1.70	1.51	1.73	1.93	1.96	1.80	2.47	3.62	3.11	2.28
PHB 65A70	2.77	1.31	3.45	2.61	2.56	2.47	2.17	2.58	2.11	2.08	2.09	1.67	1.96	1.62	1.49	1.89	2.80	3.66	3.15	2.34
SY4200	2.46	1.11	3.39	2.80	2.96	2.30	2.21	2.28	1.92	2.25	1.88	1.63	2.21	1.55	1.84	1.74	2.35	3.31	3.71	2.31
SY4045	2.59	1.15	3.01	2.73	2.88	1.96	1.73	1.23	1.88	2.39	2.20	1.83	1.42	2.00	2.14	2.11	2.14	2.59	2.58	2.13
Mean	2.79	1.22	3.66	2.73	2.79	2.44	2.14	2.75	1.96	2.05	2.06	1.71	2.15	1.78	1.89	1.91	2.64	3.42	3.85	
CV	12	17	9	11	11	10	18	12	11	7	9	8	16	14	18	18	13	14	9	

■ Agricol; ▲ ARC-GCI; ◆ Capstone; ● Pannar; ✚ Pioneer; ■ Syngenta.

Table 8 Oil yield (t ha^{-1}) of cultivars at selected localities 2013/2014

Cultivar	Locality												
	Bainsvlei 20/11/2013 ●	Boskop 04/01/2014 ✚	Delmas 06/11/2013 ●	Kroonstad 14/12/2013 ✚	Lichtenburg 09/01/2014 ●	Ottosdal 13/12/2013 ✚	Potchefstroom 3/11/2013 ▲	Potchefstroom 20/1/2014 ▲	Senekal 20/12/2013 ●	Setlers 16/01/2014 ●	Wesselsbron 11/12/2013 ●	Viljoenskroon 20/12/2013 ✚	Mean
Agsun 5264	1.08	1.57	1.24	1.18	0.76	1.05	0.91	0.79	0.92	0.72	1.85	1.89	1.13
Agsun 5270	1.19	1.79	1.09	1.13	1.02	1.40	1.02	0.71	0.97	0.72	1.52	1.81	1.21
Agsun 5271	1.35	1.70	1.02	1.11	0.91	1.25	0.94	0.68	0.80	0.72	1.59	1.81	1.07
Agsun 5278	1.08	1.56	1.23	1.06	0.93	1.32	0.81	0.85	0.91	0.72	1.21	1.59	1.09
Agsun 5279	1.33	1.79	1.05	1.03	0.84	1.27	0.77	0.73	1.10	0.76	1.31	1.84	1.14
Agsun 8251	1.42	1.59	1.27	1.14	0.95	1.06	0.83	0.48	0.81	0.69	1.58	1.85	1.12
CAP 4000	1.14	1.31	1.08	0.85	0.79	1.02	0.90	0.74	1.05	0.69	1.41	1.49	1.04
PAN 7033	1.20	1.59	0.97	1.07	0.81	1.06	0.95	0.54	0.82	0.67	1.24	1.60	1.04
PAN 7049	1.43	1.67	1.27	1.03	0.73	1.23	1.19	0.71	0.94	0.88	1.45	1.51	1.17
PAN 7057	0.89	1.69	1.15	1.03	0.78	1.31	1.11	0.70	0.95	0.69	1.06	1.69	1.09
PAN 7080	1.54	1.53	1.15	1.04	0.92	1.31	1.02	0.63	1.23	0.74	1.43	1.72	1.20
PAN 7088	1.18	1.90	1.34	1.03	0.74	1.38	0.99	0.67	0.83	0.69	1.55	1.57	1.16
PAN 7100	1.21	1.57	1.31	1.08	0.99	1.42	1.00	0.73	1.22	0.75	1.25	1.58	1.17
PAN 7085CL	1.43	1.53	1.44	0.98	0.83	1.05	0.90	0.62	1.26	0.86	1.44	1.60	1.15
PAN 7101CL	1.42	1.50	1.11	0.96	0.66	0.95	0.73	0.58	0.91	0.47	1.14	1.33	0.98
PAN 7102CLP	1.05	1.25	1.15	1.00	0.90	1.11	0.92	0.72	0.92	0.73	1.30	1.60	1.05
PHB 65A25	1.27	1.55	0.99	1.00	1.10	1.00	0.82	0.63	0.85	0.67	1.59	1.44	1.10
PHB 65A70	1.21	1.43	1.14	1.07	0.87	1.04	0.97	0.68	0.87	0.67	1.52	1.32	1.07
SY4200	1.26	1.70	1.22	1.00	0.91	0.98	1.02	0.62	0.80	0.69	1.45	1.56	1.04
SY4045	1.22	1.24	1.19	0.81	0.69	0.51	0.89	0.72	0.85	0.83	1.02	1.06	0.90
Mean	1.24	1.58	1.17	1.03	0.86	1.14	0.93	0.67	0.88	0.72	1.40	1.58	

*◆ Agtest; ▲ ARC-GCI; ✚ Capstone; ● Pannar; ■ Pioneer; ■ Syngenta.

Table 9 Parameters calculated from the analysis of variance for yield data at each locality 2013/2014

Locality	Mean (t/ha)	SE (t/ha)	CV (%)	GCV (%)	t	SE(t)	tn
Bainsvlei 20/11/2013 ●	2.79	0.19	12	10	0.39	0.14	0.66
Bethlehem 31/12/2013 ♦	1.22	0.12	17	5	0.08	0.14	0.20
Boskop 04/01/2014 ♠	3.86	0.19	9	7	0.35	0.15	0.62
Delmas 06/11/2013 ●	2.73	0.17	11	8	0.41	0.14	0.67
Gerdau 13/12/2013 ⌀	2.79	0.18	11	10	0.45	0.14	0.71
Kroonstad 14/12/2013 ♠	2.44	0.14	10	8	0.25	0.15	0.50
Lichtenburg 09/01/2014 ●	2.14	0.66	18	4	0.08	0.14	0.15
Ottosdal 13/12/2013 ♠	2.75	0.19	12	18	0.71	0.09	0.88
Potchefstroom 13/11/2013 ▲	1.96	0.12	11	7	0.28	0.15	0.54
Potchefstroom 06/12/2013 ▲	2.05	0.08	7	7	0.52	0.13	0.77
Potchefstroom 09/01/2014 ▲	2.06	0.11	9	8	0.30	0.15	0.57
Potchefstroom 20/01/2014 ▲	1.71	0.08	8	7	0.42	0.14	0.69
Senekal 20/12/2013 ●	2.15	0.20	18	14	0.42	0.14	0.69
Settlers 09/01//2014 ¤	1.78	0.14	14	4	0.08	0.14	0.21
Settlers 16/01/2014 ●	1.81	0.19	18	<1	<0.01	0.13	<0.01
Settlers 16/01/2014 ●	1.89	0.19	18	10	0.25	0.15	0.50
Viljoenskroon 20/12/2013 ♠	3.85	0.20	9	8	0.49	0.13	0.74
Wesselsbron 11/12/2013 ●	3.42	0.28	14	8	0.22	0.15	0.46
Wesselsbron 27/11/2013 ♠	2.84	0.20	13	8	0.16	0.15	0.37

SE : Standard error of trial mean
CV : Error coefficient of variation
GCV : Genetic coefficient of variation
t : Intra class correlation

SE(t) : Standard error of t
tn : Repeatability of cultivar mean
* : Not used for calculation of reliability

♠ Agricol; ▲ ARC-GCI; ♦ Capstone; ● Pannar; ⌀ Pioneer; ¤ Syngenta

Table 10 Regression line coordinates at different yield targets 2013/2014

Cultivar	Yield potential (t ha^{-1})						Mean (t ha^{-1})	Inter-cept	Slope	D-parameter
	1	1.5	2	2.5	3	3.5				
Agsun 5264	0.95	1.42	1.89	2.36	2.83	3.30	2.27	0.009	0.941	0.06
Agsun 5270	0.87	1.45	2.04	2.62	3.20	3.78	2.51	-0.296	1.166	0.06
Agsun 5271	0.87	1.43	2.00	2.56	3.13	3.69	2.46	-0.259	1.129	0.05
Agsun 5278	0.90	1.44	1.98	2.52	3.06	3.60	2.42	-0.182	1.081	0.05
Agsun 5279	0.92	1.46	1.99	2.53	3.07	3.61	2.43	-0.153	1.074	0.07
Agsun 8251	0.84	1.42	2.01	2.60	3.19	3.78	2.50	-0.345	1.180	0.02
CAP 4000	0.98	1.47	1.96	2.44	2.93	3.42	2.35	0.011	0.973	0.04
PAN 7033	0.98	1.48	1.98	2.47	2.97	3.47	2.38	-0.014	0.995	0.03
PAN 7049	1.21	1.69	2.17	2.65	3.12	3.60	2.56	0.248	0.959	0.04
PAN 7057	1.10	1.57	2.04	2.50	2.97	3.44	2.42	0.168	0.934	0.08
PAN 7060	1.00	1.58	2.15	2.72	3.29	3.86	2.61	-0.139	1.144	0.06
PAN 7088	0.86	1.46	2.06	2.65	3.25	3.85	2.54	-0.337	1.196	0.07
PAN 7100	1.25	1.70	2.16	2.61	3.07	3.52	2.53	0.343	0.908	0.03
PAN 7095GL	0.95	1.50	2.04	2.59	3.13	3.68	2.49	-0.135	1.090	0.08
PAN 7101GL	0.83	1.34	1.85	2.36	2.87	3.38	2.26	-0.196	1.022	0.09
PAN 7102GLP	1.17	1.59	2.01	2.43	2.85	3.27	2.35	0.326	0.842	0.02
PHB 65A25	0.95	1.42	1.89	2.36	2.84	3.31	2.28	0.010	0.942	0.10
PHB 65A70	1.03	1.50	1.96	2.43	2.89	3.36	2.34	0.105	0.929	0.04
SY4200	0.94	1.43	1.91	2.40	2.89	3.38	2.31	-0.034	0.975	0.03
SY4045	1.39	1.66	1.92	2.18	2.44	2.70	2.13	0.872	0.522	0.17

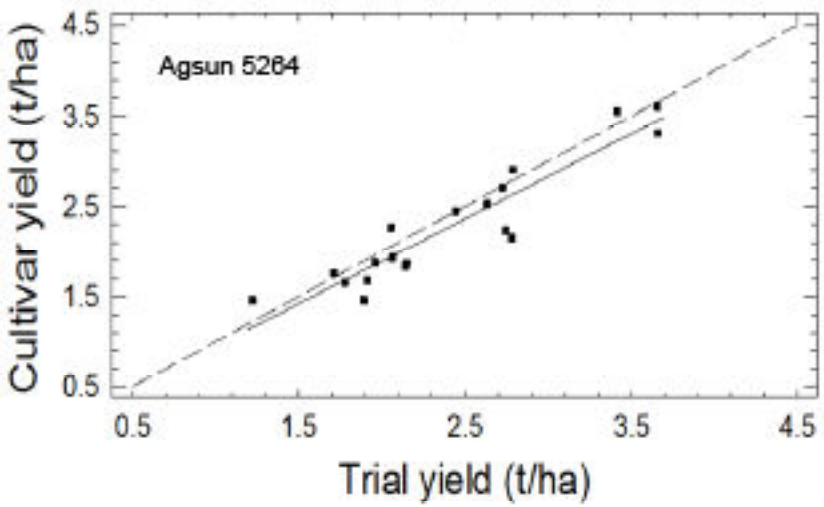
Table 11 Yield probability (%) of cultivars 2013/14

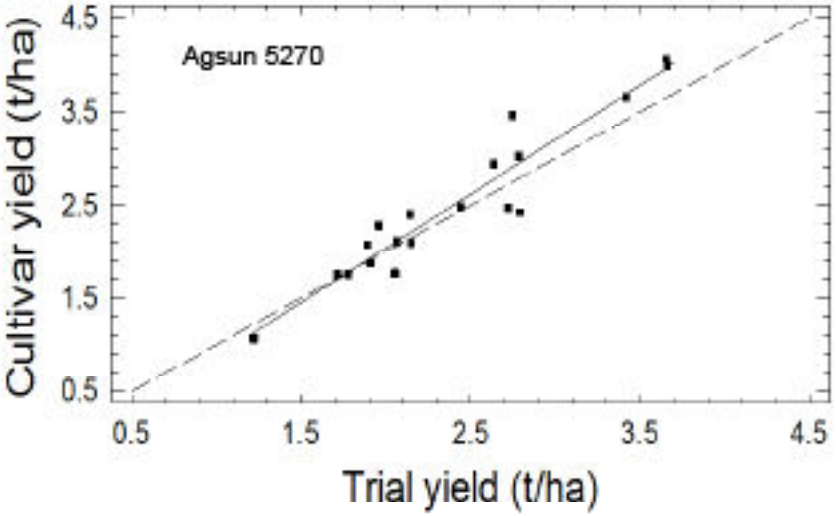
Cultivar	Yield potential (t ha^{-1})					
	1	1.5	2	2.5	3	3.5
Agsun 5264	42	38	33	28	25	22
Agsun 5270	31	43	56	68	79	86
Agsun 5271	30	39	50	60	70	78
Agsun 5278	34	40	47	53	60	66
Agsun 5279	38	43	49	55	61	66
Agsun 8251	21	35	53	71	84	92
CAP 4000	47	45	42	40	37	36
PAN 7033	47	46	46	45	45	44
PAN 7049	81	79	77	74	71	67
PAN 7057	64	60	55	50	45	41
PAN 7080	51	62	73	81	88	92
PAN 7088	30	43	59	73	84	91
PAN 7100	87	83	78	71	62	54
PAN 7095CL	44	50	57	63	69	74
PAN 7101CL	27	28	29	30	32	34
PAN 7102CLP	80	66	52	38	27	18
PHB 85A25	43	40	36	34	31	29
PHB 85A70	56	50	44	39	34	30
SY4200	39	37	36	34	33	32
SY4045	89	68	41	19	8	3

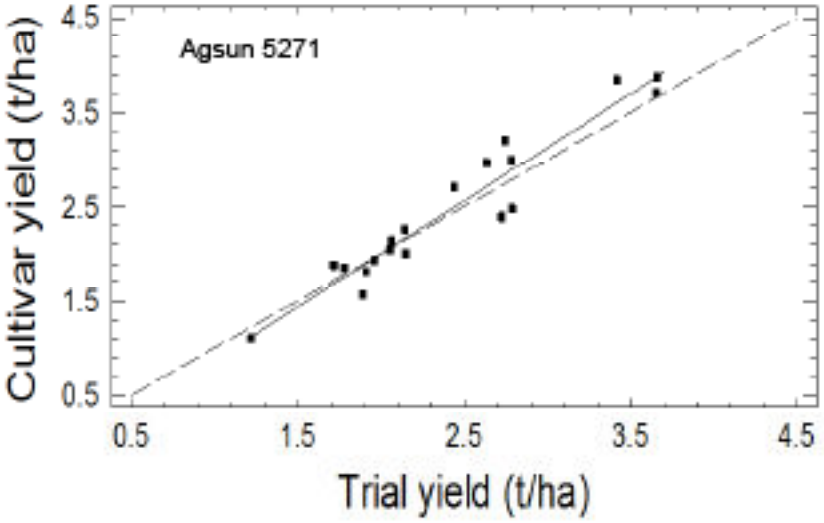
Table 12 Yield probability (%) of cultivars 2012/13 and 2013/14

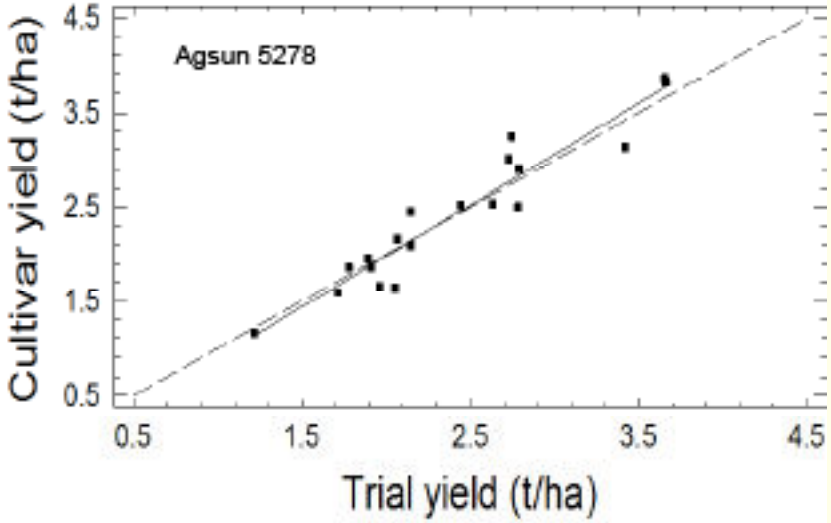
Cultivar	Yield potential (t ha^{-1})					
	1	1.5	2	2.5	3	3.5
AGSUN 5264	45	40	35	31	27	24
AGSUN 5270	43	55	67	77	85	90
AGSUN 5271	30	39	50	62	72	80
AGSUN 5278	56	57	59	60	61	62
AGSUN 8251	45	55	66	75	83	88
CAP4000	28	23	19	16	13	12
PAN 7033	51	49	47	45	43	42
PAN 7049	61	66	70	74	78	80
PAN 7057	54	53	52	51	49	48
PAN 7080	57	68	78	85	91	94
PAN 7095CL	72	71	70	69	67	65
PNR 65A25	48	38	31	25	20	17
SY 4045	78	60	38	19	8	3
SY 4200	43	38	30	24	20	17

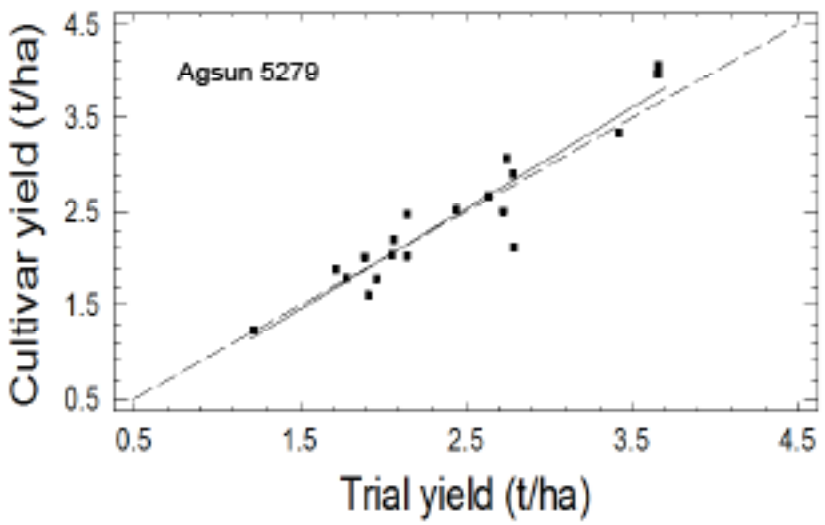
Figure 1: Regression lines for cultivars 2013/2014

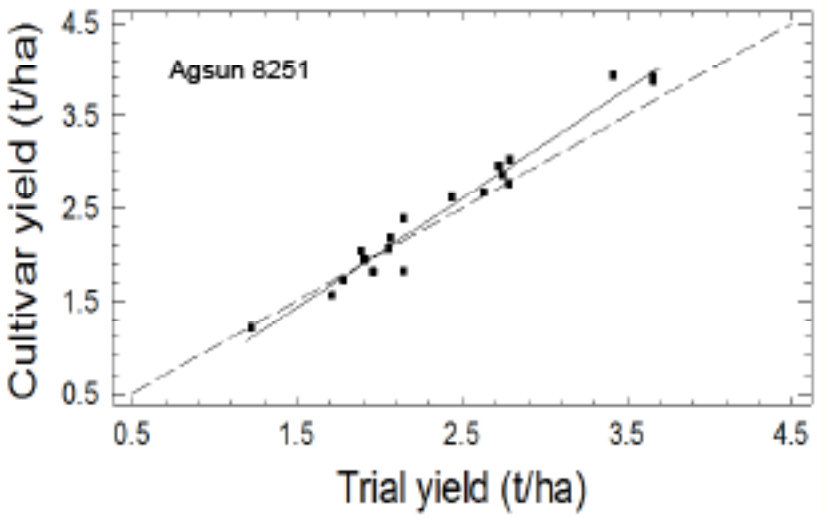


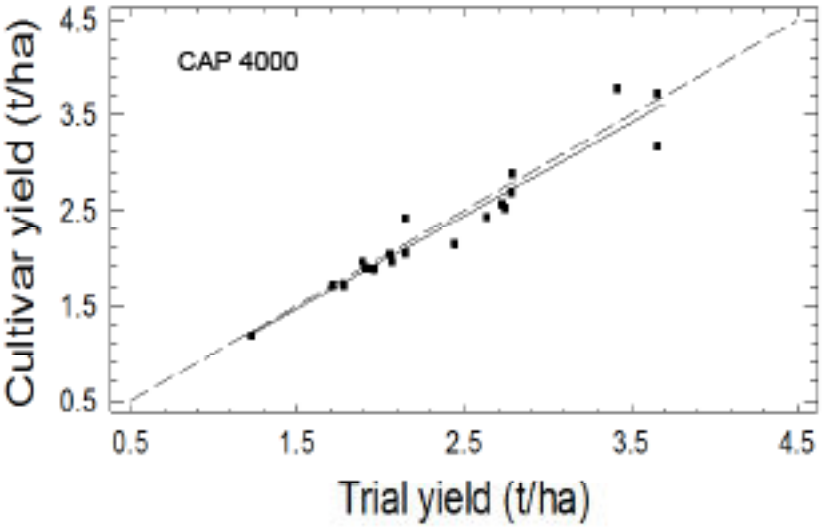


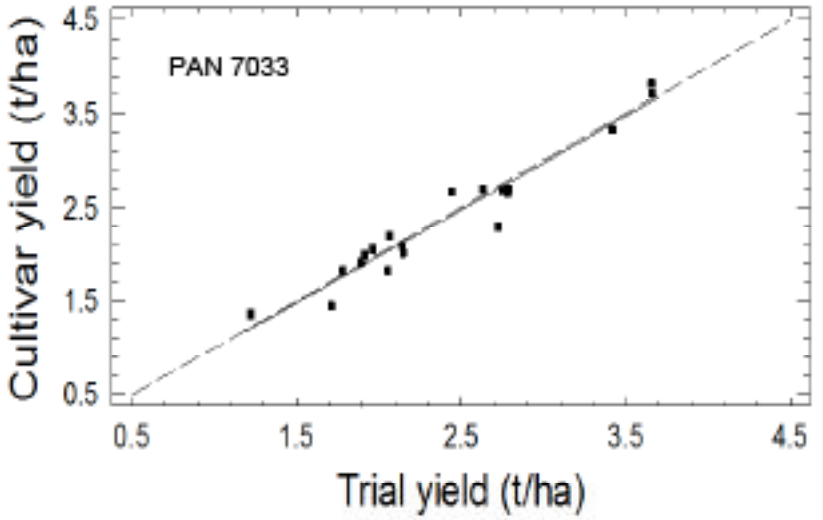


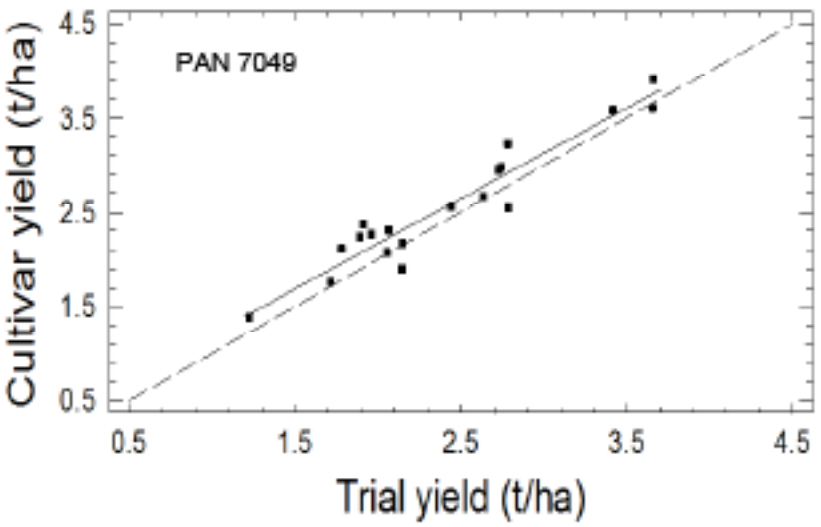



Agsun 5279
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5


Agsun 8251
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5


CAP 4000
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5


PAN 7033
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5


PAN 7049
Cultivar yield (t/ha)
Trial yield (t/ha)
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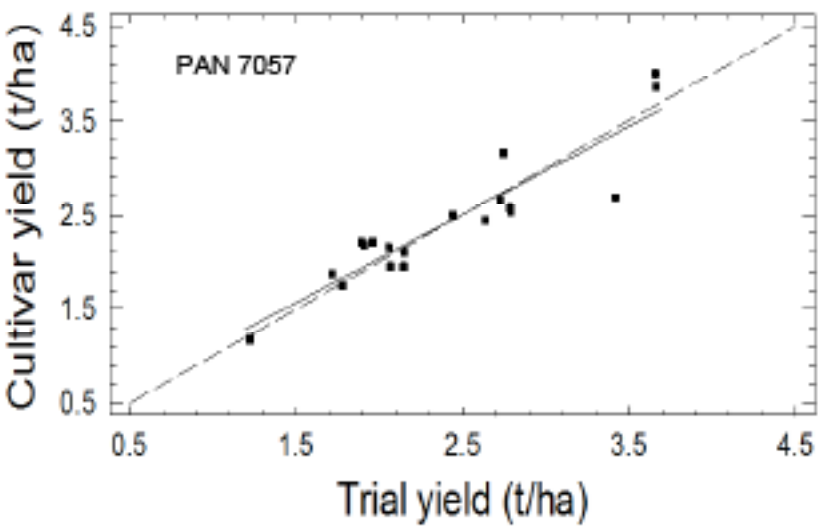
1.5
2.5
3.5
4.5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Cultivar yield (t/ha)
Trial yield (t/ha)
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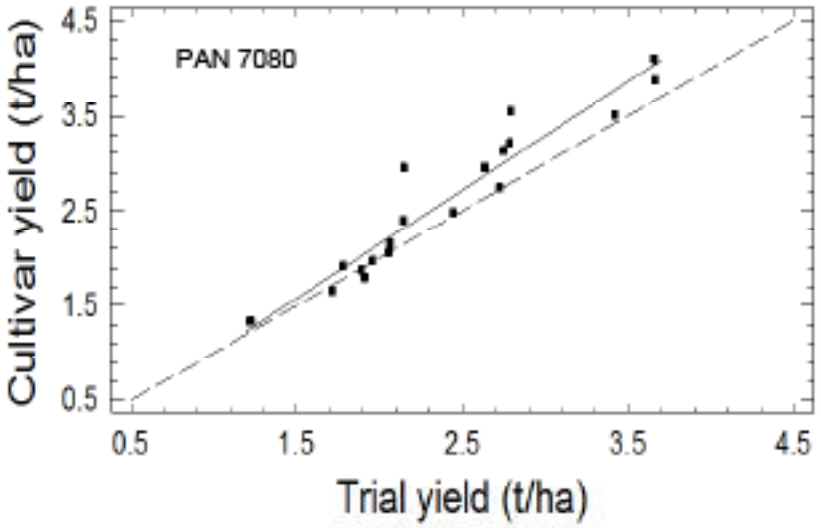
1.5
2.5
3.5
4.5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Cultivar yield (t/ha)
Trial yield (t/ha)
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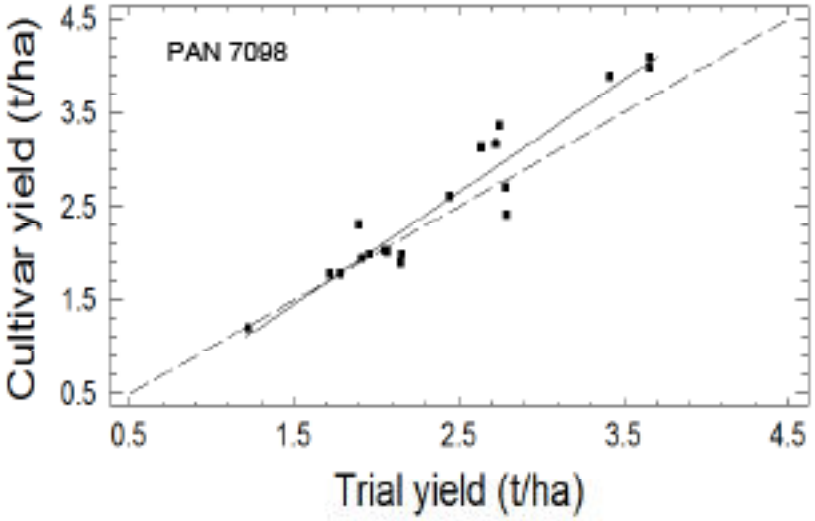
1.5
2.5
3.5
4.5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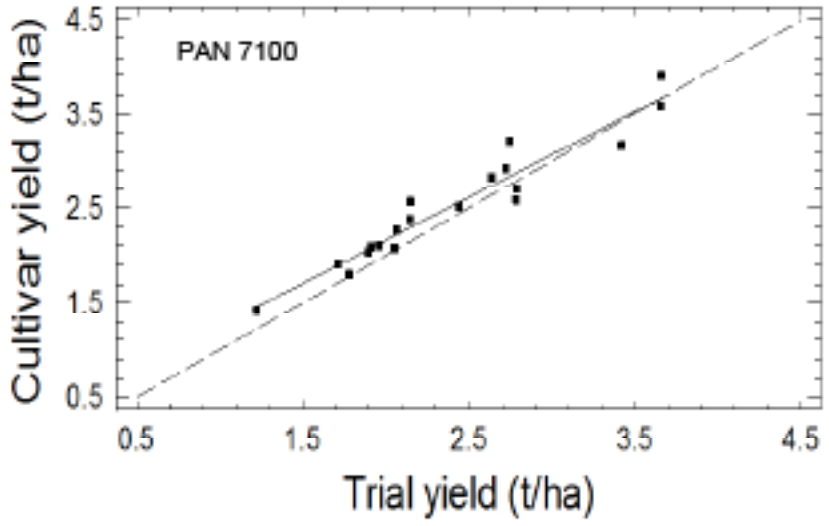
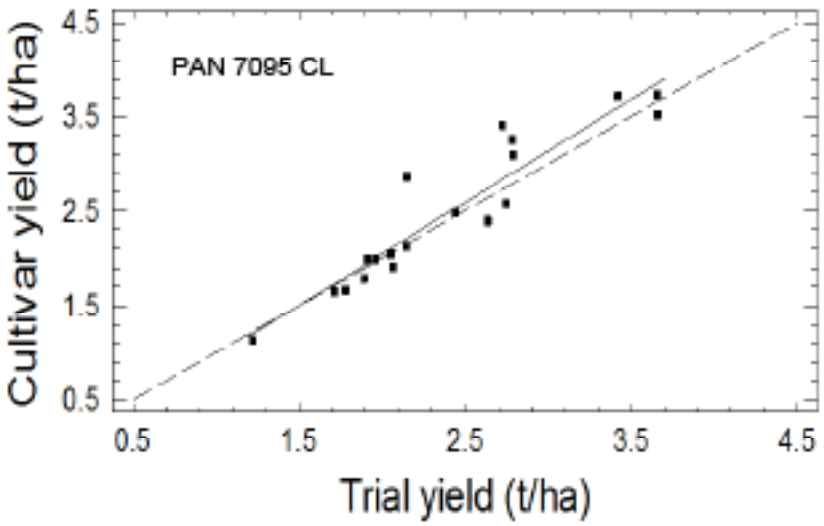
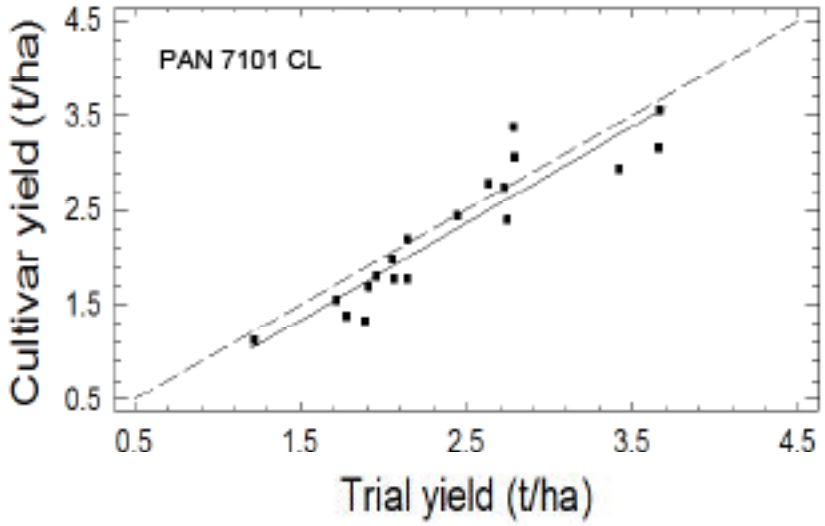
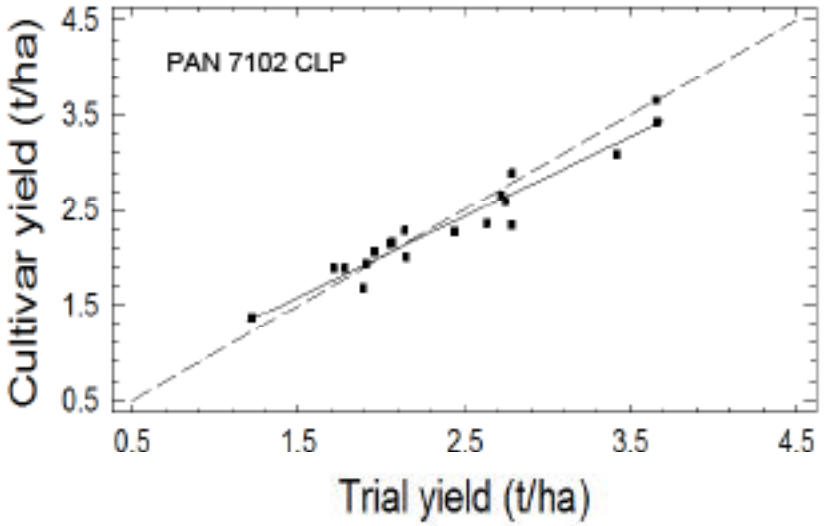
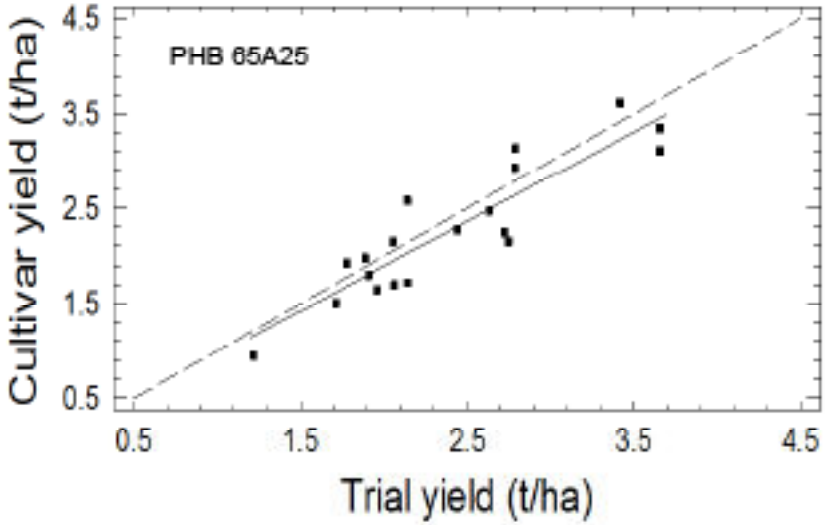
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5

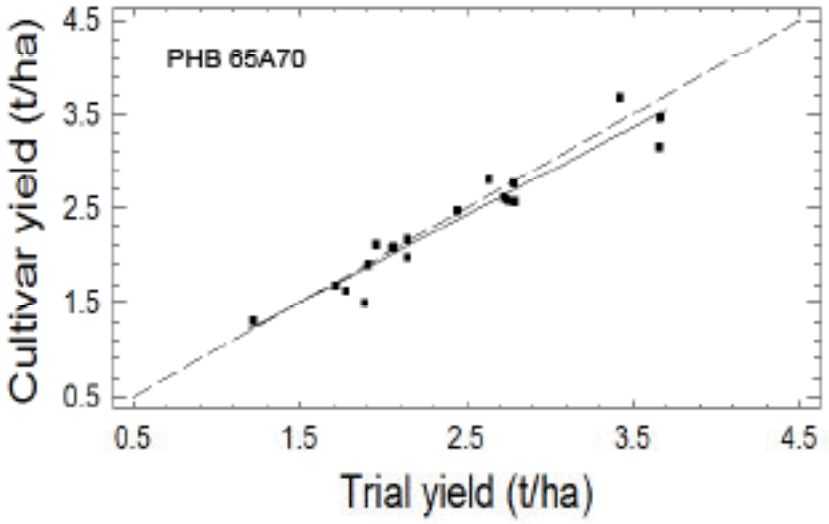

PAN 7100
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5

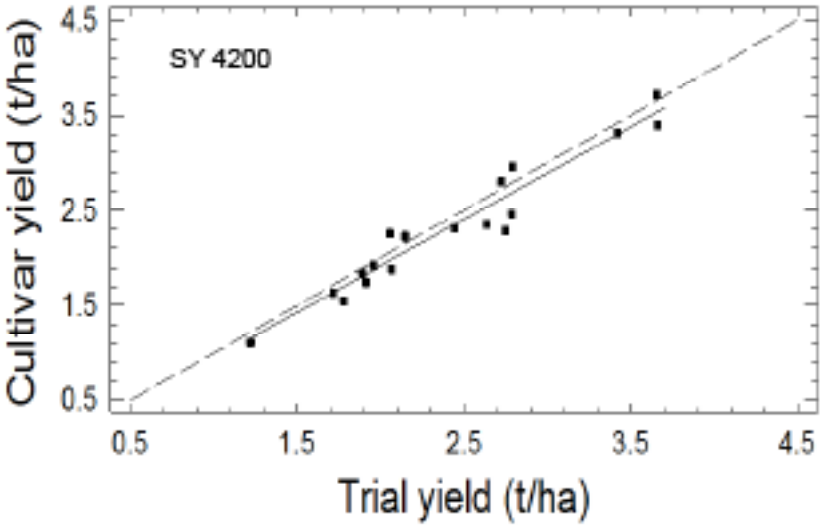

PAN 7095 CL
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5


PAN 7101 CL
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5


PAN 7102 CLP
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5


PHB 65A25
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5


PHB 65A70
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5


SY 4200
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5

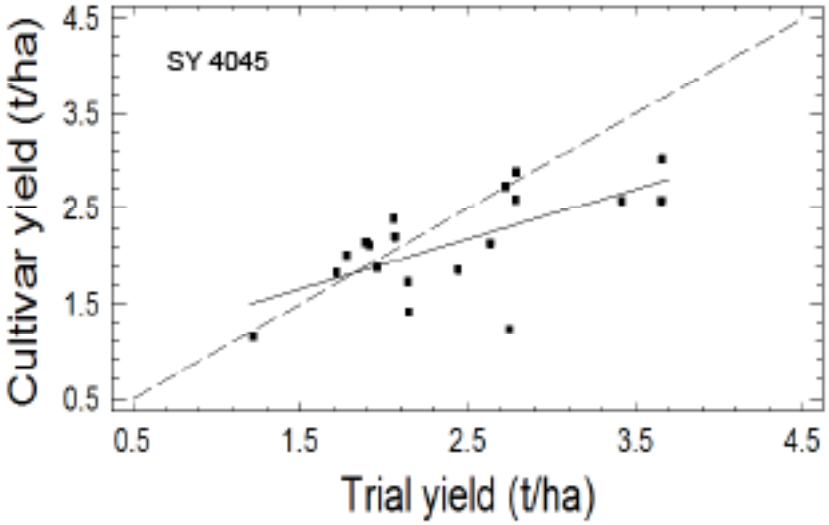
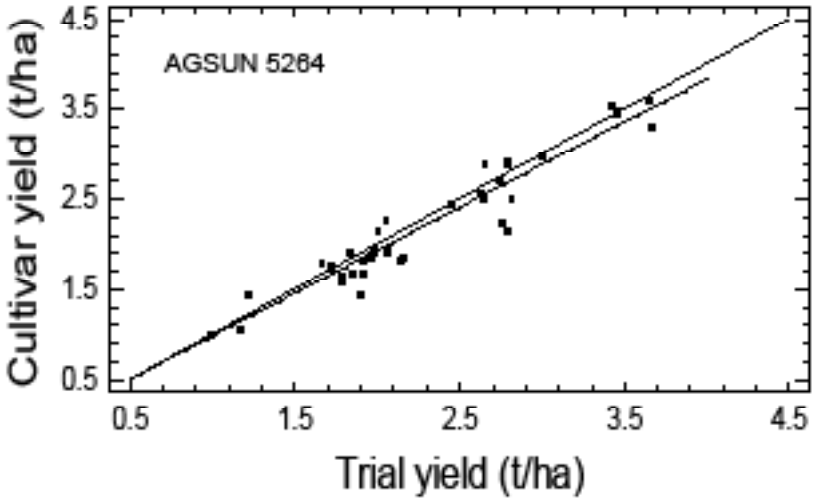
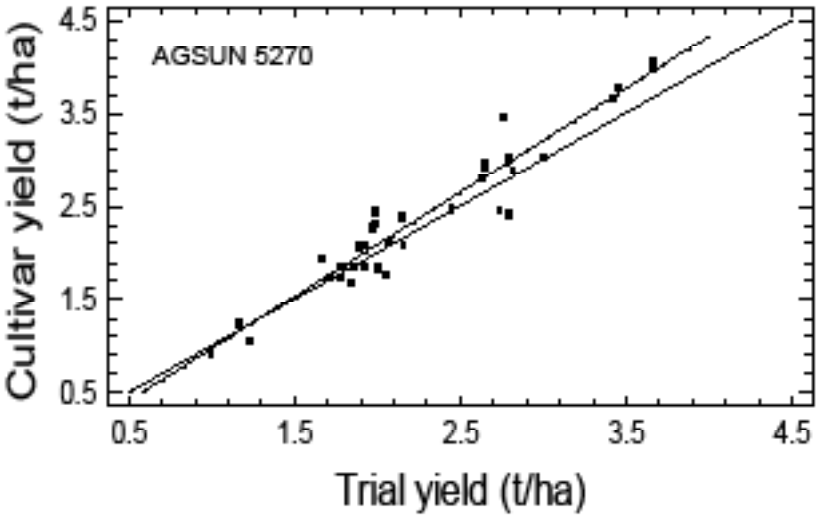
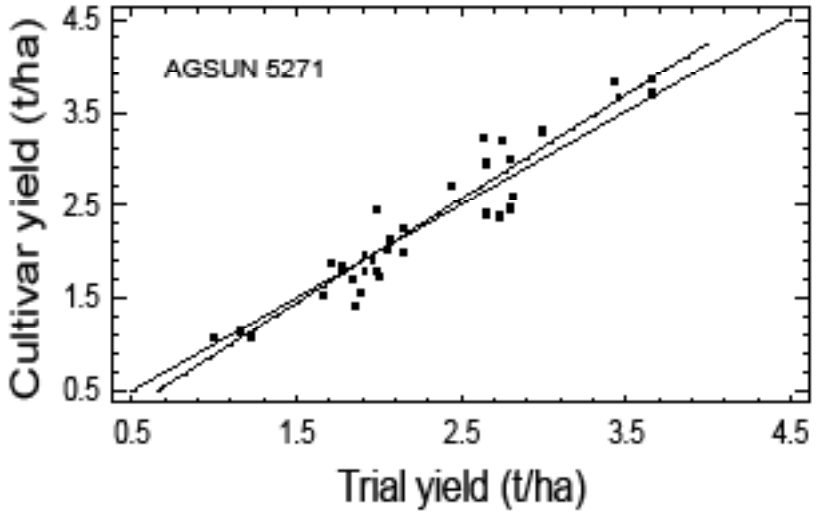
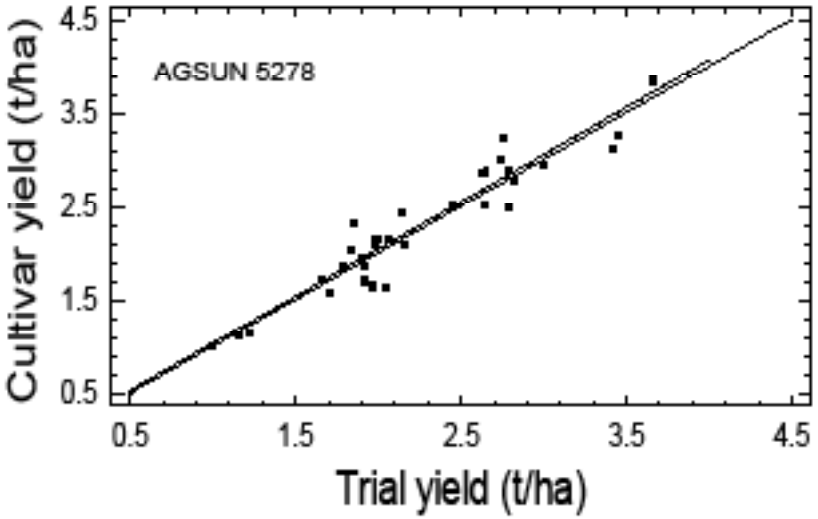

SY 4045
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5

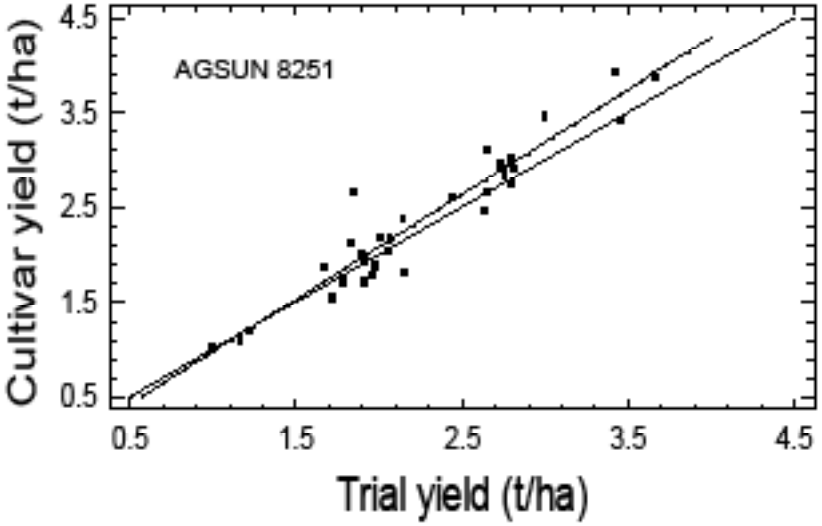
Figure 2: Regression lines for cultivars 2012/2013 and 2013/2014

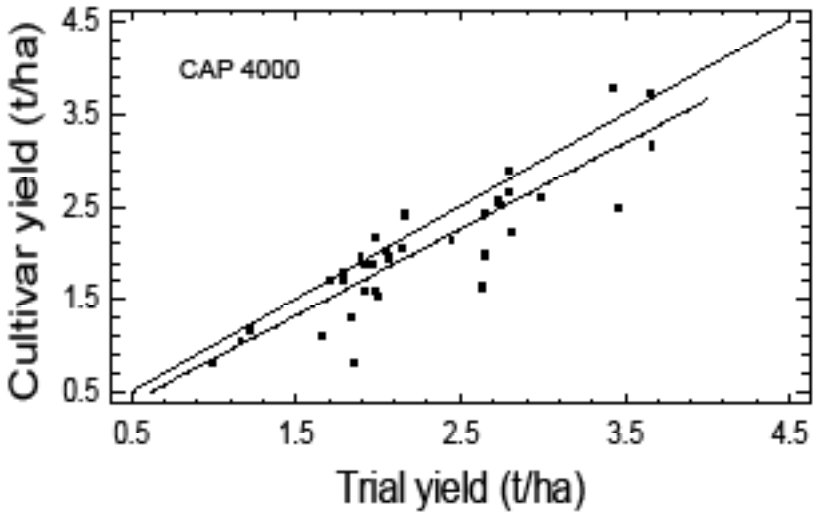


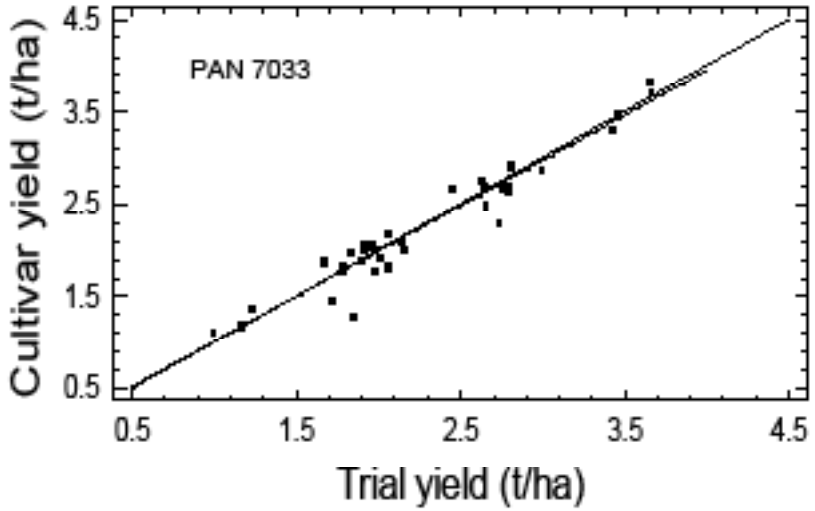


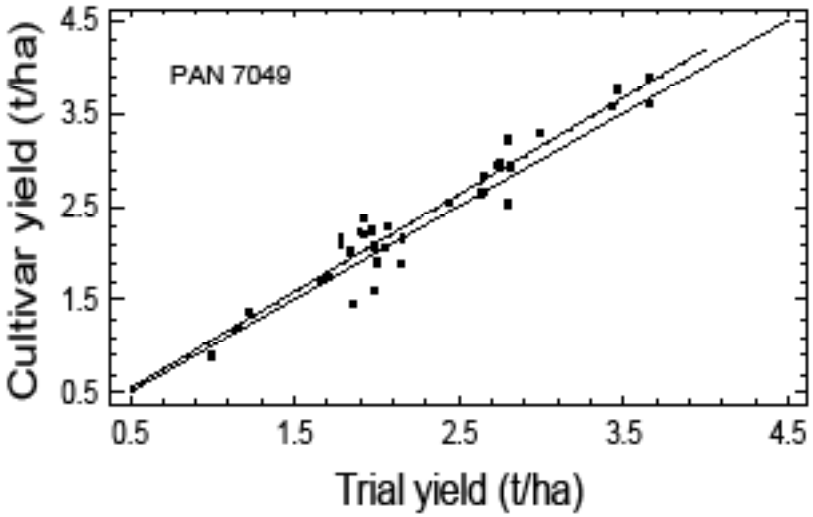


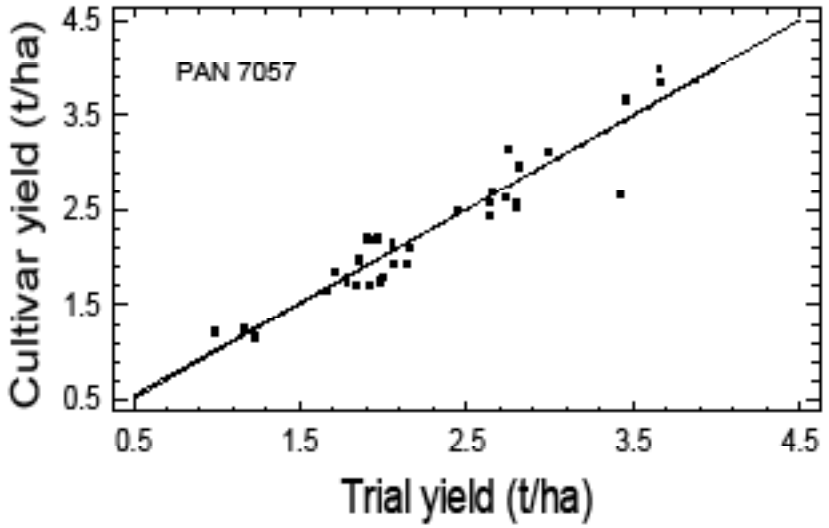


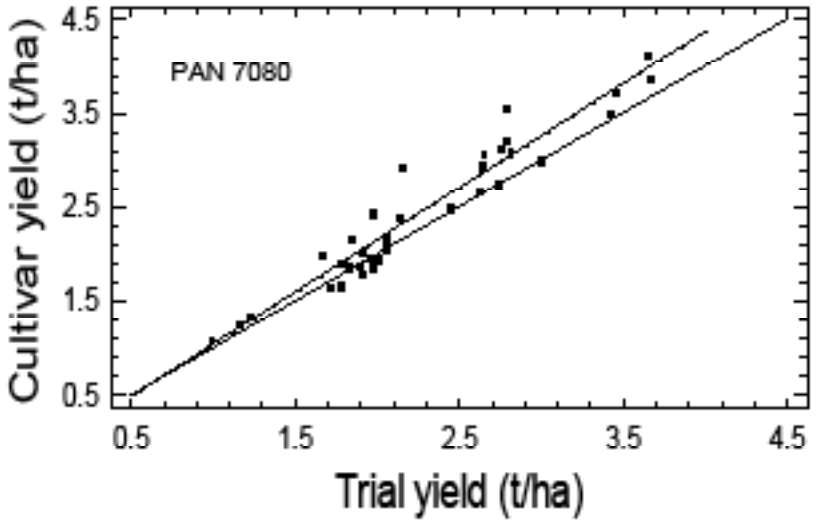

AGSUN 8251
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5

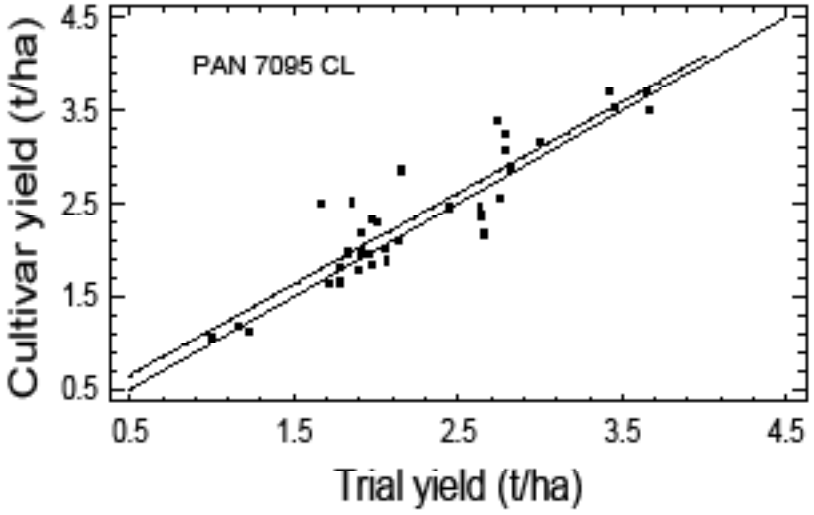

CAP 4000
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5

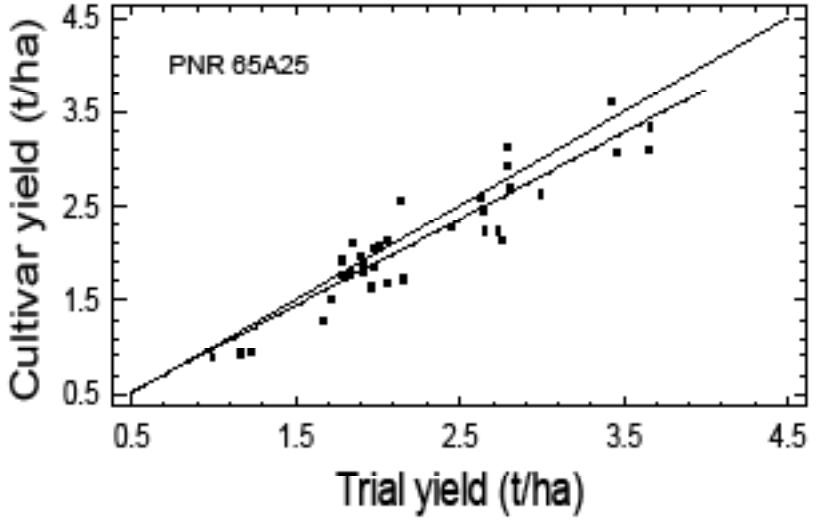

PAN 7033
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5

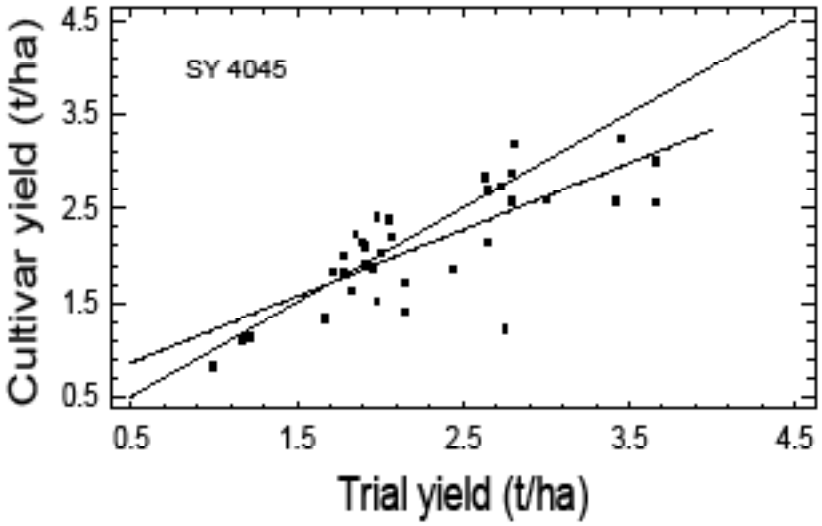

PAN 7049
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5

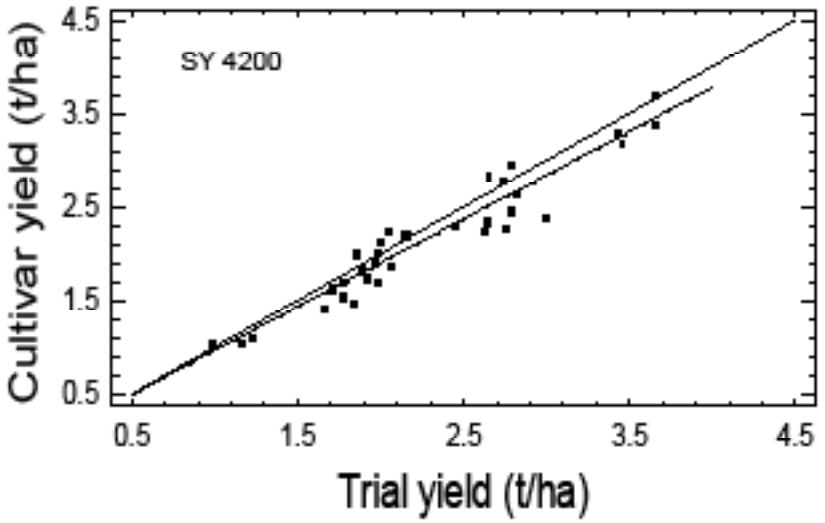

PAN 7057
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5


PAN 7080
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5


PAN 7095 CL
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5


PNR 65A25
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5


SY 4045
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5


SY 4200
Cultivar yield (t/ha)
Trial yield (t/ha)
0.5
1.5
2.5
3.5
4.5