# Report

# Evaluation of sunflower cultivars: 2019/2020 season

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

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

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

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

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

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

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

**RESULTS**

**Days from planting to flowering**

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

**Oil and protein concentration**

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

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analyses were done according to the Dumas method.

The moisture free oil content for cultivars at the various localities varied from 37.62 to 50.61% with an overall mean of 42.12%.

The highest mean oil concentration among localities was at Potchefstroom (planting date 18 December 2019) with 45.90%. The locality with the lowest mean oil content of 36.82% was Potchefstroom planting date was February 05, 2019. The highest oil concentration among cultivars and calculated across localities, was SY 3970 CL at 50.61% followed by RN 28584 at 48.36%

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

**Seed yield**

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

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

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

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**Oil yield**

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

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

**Parameters calculated from the analysis of variance**

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

**Regression line coordinates at different yield targets**

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

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

**Yield probability**

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

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

**Acknowledgements**

**References**

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

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

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

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

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

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**Table 3: Trial site information 2019/20 season**

| Locality | Planting date | Plant population | Soil classification | Top soil analysis (mg kg⁻¹) pH (KCl) | P | K | Ca | Mg | Fertiliser applied (Kg ha⁻¹) | Row width (cm) | Weed control and insecticides | Net plot size (m²) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boskop 1 | 30/10/2019 | 40 000 | - | - | - | - | - | - | - | 91 | Alanex and Karate | 11.83 |
| Boskop 2 | 19/11/2019 | 40 000 | - | - | - | - | - | - | - | 91 | Alanex and Karate | 11.83 |
| Boskop 3 | 17/12/2019 | 40 000 | - | - | - | - | - | - | - | 91 | Alanex and Karate- | 11.83 |
| Bothaville | 18/12/2019 | 40 000 | - | - | - | - | - | - | - | 91 | Mechanical weeding - | 11.83 |
| Makwassie | 19/12/2019 | 40 000 | - | - | - | - | - | - | - | 91 | Mechanical weeding | 11.83 |
| Wolmaranstad | 06/01/2020 | 40 000 | - | - | - | - | - | - | - | 91 | Mechanical weeding | 11.83 |
| Leeudoringstad | 14/01/2020 | 40 000 | - | - | - | - | - | - | - | 91 | Mechanical weeding | 11.83 |
| Ventersdorp | 15/01/2020 | 40 000 | - | - | - | - | - | - | - | 91 | Mechanical weeding | 11.83 |
| Potchefstroom | 04/11/2019 | 40 000 | - | 6,29 | 55 | 290 | 1033 | 475 | N:98,P:8.3,K:4.1 | 90 | Frontier Optima and Gramaxome | 14.40 |
| Potchefstroom | 21/11/2019 | 40 000 | - | 6,67 | 74 | 303 | 1095 | 573 | N:105,P:8.3,K:4.1 | 90 | Metagen Gold and Gramaxone | 12.60 |
| Potchefstroom | 18/12/2019 | 40 000 | - | 6,67 | 74 | 303 | 1095 | 573 | N:105,P:8.3,K:4.1 | 90 | Metagen Gold and Gramaxome | 12.60 |
| Potchefstroom | 23/01/2020 | 40 000 | - | 6,26 | 23 | 185 | 1093 | 468 | N:108,P:8.3,K:4.1 | 90 | Frontier Optima and Gramaxome | 12.60 |
| Potchefstroom | 05/02/2020 | 40 000 | - | 6,26 | 23 | 185 | 1093 | 468 | N:108,P:8.3,K:4.1 | 90 | Frontier Optima and Gramaxome | 12.60 |
| Valsrivier | 03/01/2020 | 40 000 | - | - | - | - | - | - | - | 91 | - | 12.74 |
| Kroonstad | 17/01/2020 | 40 000 | - | - | - | - | - | - | - | - | - | 10.92 |
| Sannieshof | 16/01/2020 | 40 000 | - | - | - | - | - | - | - | - | - | 10.92 |
| Kroonstad Oos | 19/12/2019 | 40 000 | - | - | - | - | - | - | - | - | - | 13.65 |
| Kommandodrift | 03/01/2020 | 40 000 | - | - | - | - | - | - | - | - | - | 13.65 |
| Senekal | 06/01/2020 | 40 000 | - | - | - | - | - | - | - | - | - | 13.65 |
| Fochvile | 13/01/2020 | 40 000 | - | - | - | - | - | - | - | - | - | 13.65 |
| Kroonstad Wes | 15/01/2020 | 40 000 | - | - | - | - | - | - | - | - | - | 13.65 |
| Gerdau | 18/12/2019 | 40 000 | - | - | - | - | - | - | - | - | - | 13.65 |
| Coligny | 19/12/2019 | 40 000 | - | - | - | - | - | - | - | - | - | 13.65 |
| Marquard | | 40 000 | - | - | - | - | - | - | - | - | - | 13.65 |

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

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

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

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

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

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

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**Table 7: Mean seed yield (t ha⁻¹) of cultivars at each locality 2019/2020**

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

**Table 8: Oil yield (t ha⁻¹) of cultivars at selected localities 2019/2020**

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

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

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

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

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

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

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

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

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

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

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

**Figure 1: Regression lines for cultivars 2019/2020**
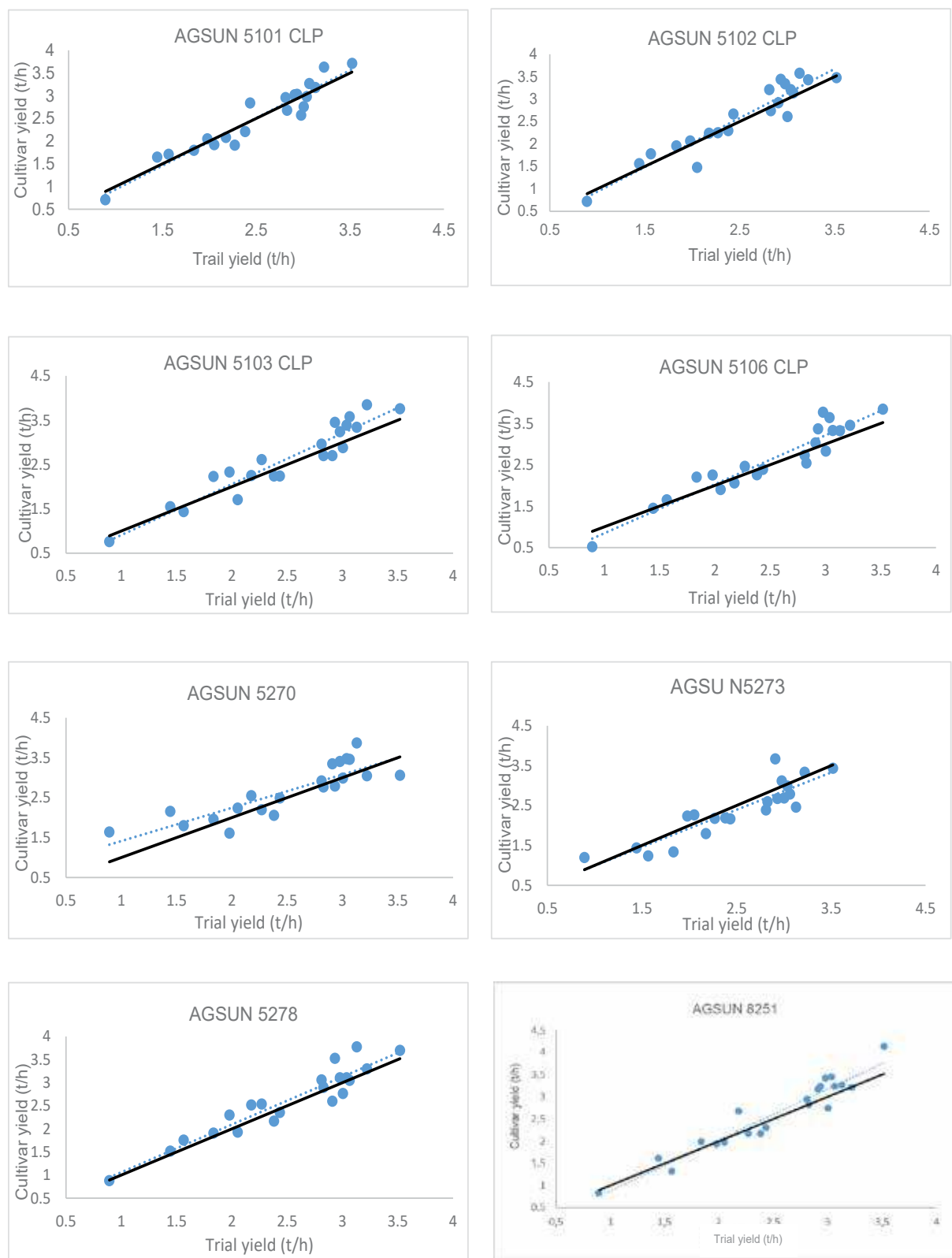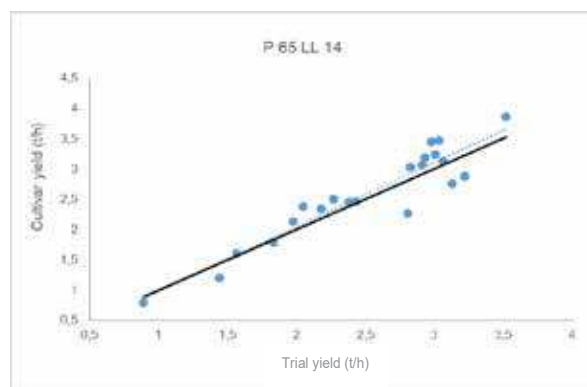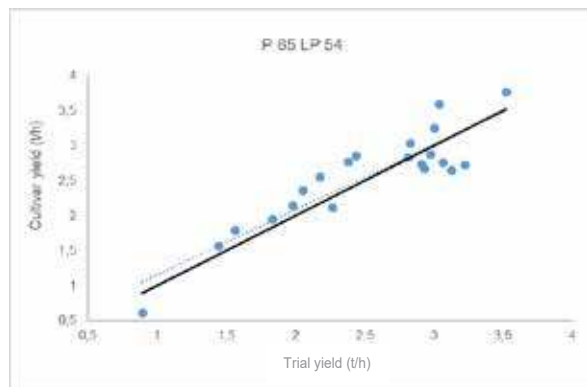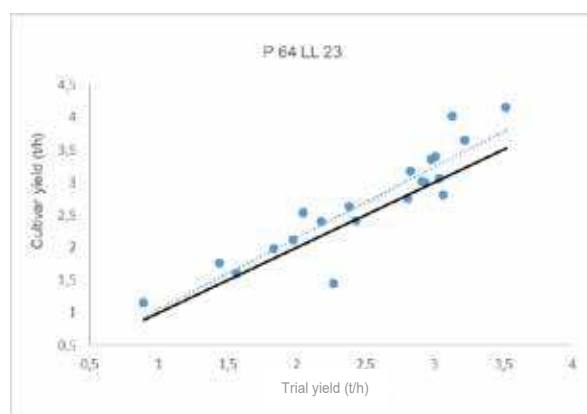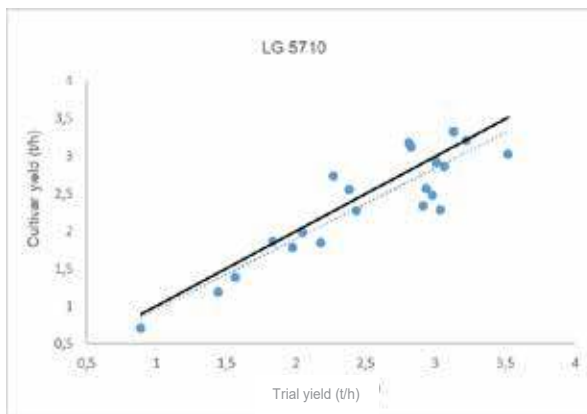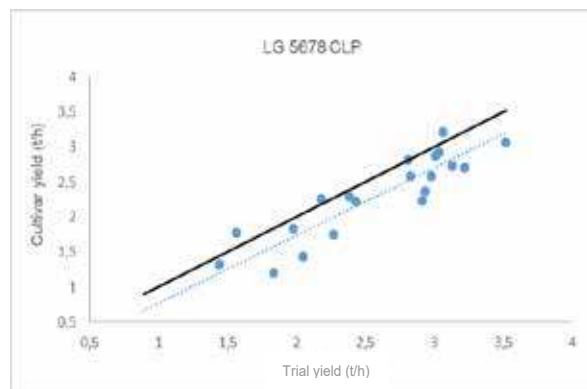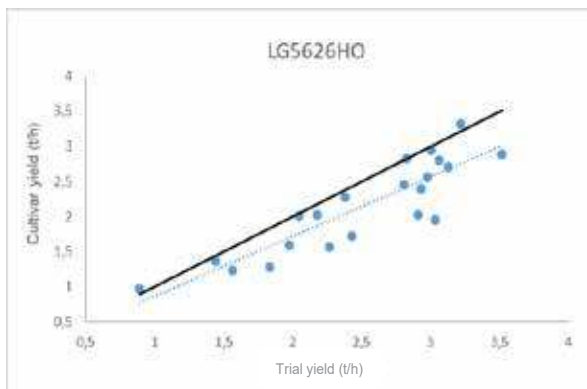


AGSUN 5101 CLP



AGSUN 5102 CLP



AGSUN 5103 CLP



AGSUN 5106 CLP



AGSUN 5270
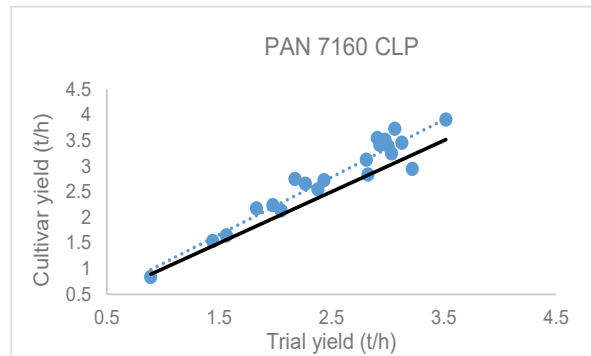


AGSU N5273



AGSUN 5278



AGSUN 8251

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

Scatter plots comparing cultivar yield (t/h) versus trial yield (t/h) for sunflower cultivars: PAN 7100, PAN 7156 CLP, PAN 7102 CLP, PAN 7160 CLP, RN 28485, RN 28584, SY 3975 CLHO, SY Arizona, and SY 3970 CL.
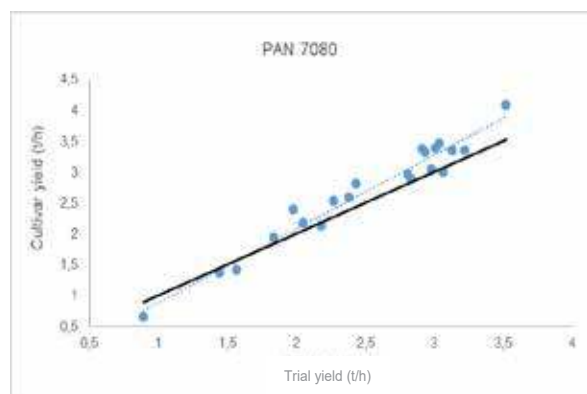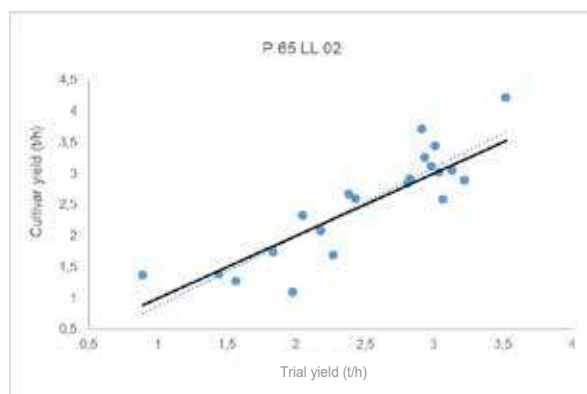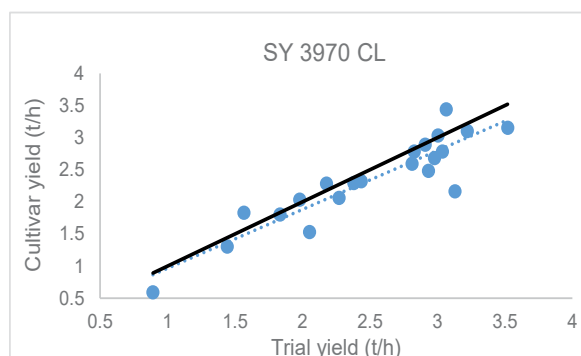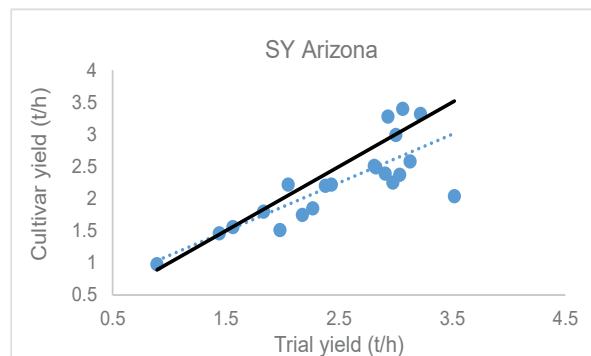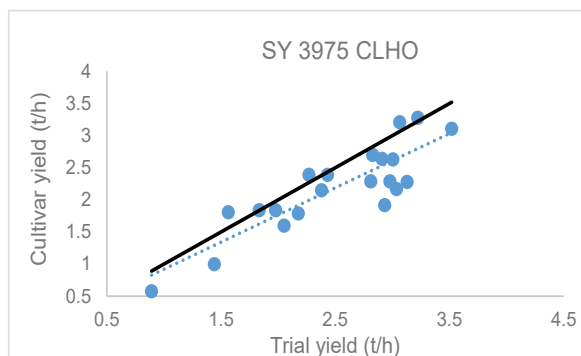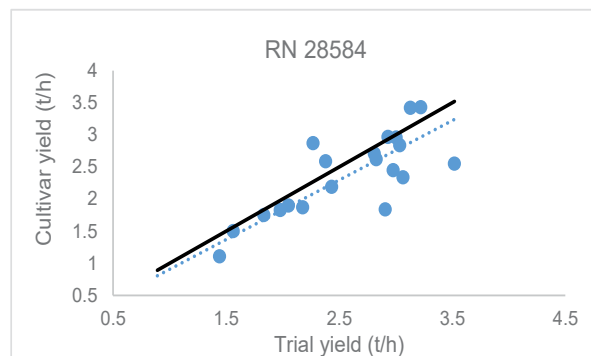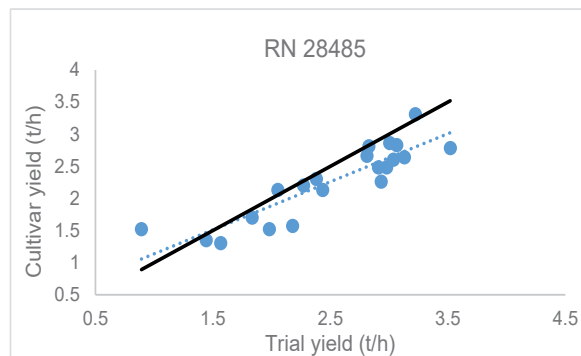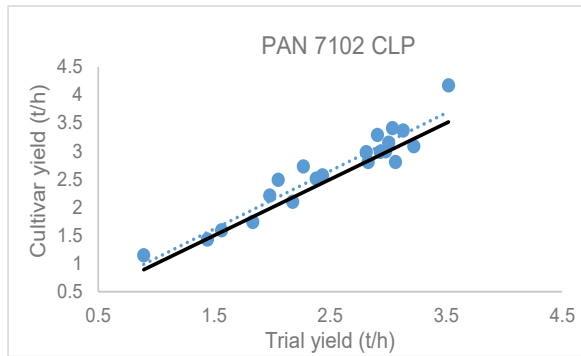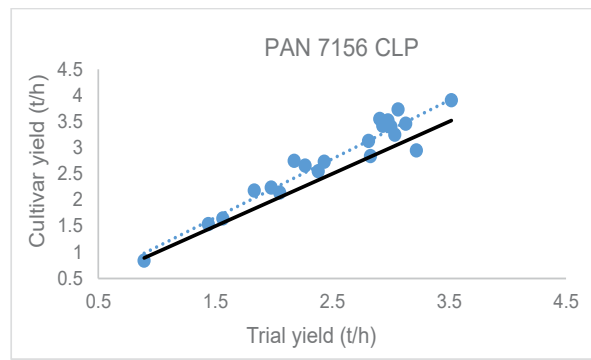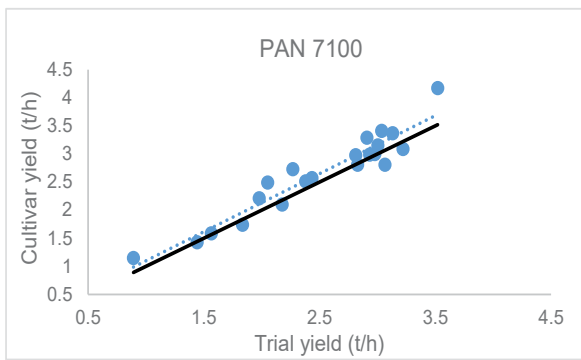
**Figure 2: Regression lines for cultivars 2018/2019 – 2019/2020**



AGSUN 5101 CLP

AGSUN 5102 CLP

AGSUN 5103 CLP

AGSUN 5106 CLP

AGSUN 5270

AGSUN 5273

AGSUN 8251

LG 5678 CLP

LG 5710



P 64 LL 23



P 65 LL 02



PAN 7100 CLP



P 65 LL 14



PAN 7156 CLP



P 65 LP 54



PAN 7160 CLP

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SY 3975 CLOH



SY 3970 CL



SY Arizona