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RESEARCH SYMPOSIUM
18 to 20 JULY 2023

CULTIVAR TRIALS

Cultivar variety is the spice of life

By Dirk Uys and Enrike Verster, Potatoes SA

Cultivar diversity plays a crucial role in the survival and sustainability of any population. Unfortunately, the lack of diversity in a population can be detrimental to its future survival. History has taught us the grave consequences that can arise from a lack of diversity, as exemplified by the devastating 1845 Irish potato famine.

Irish producers favoured the widely popular "Lumper" potato due to its impressive yields. However, this singular focus on one variety proved to be a fatal mistake as the Lumper potato was highly susceptible to late blight. The resulting potato famine reminds us how a lack of diversity can influence the fate of an entire nation.

Improved efficiencies

South Africa has taken remarkable strides in its potato yields in the past decade. Through improved agronomic practices and efficiencies, we have surpassed 100 tons/ha in many areas, including in some of our cultivar trials. I believe we can even break the current world record of 109 tons/ha held by an Indian producer. Maybe this is a challenge for our innovation suppliers to take on.

This special issue of *CHIPS* presents an analysis of ten cultivar trials conducted in diverse local geographical areas, across different seasons. Our objective is to observe how potato varieties adapt to varying conditions. Can we draw inspiration from the wine industry's concept of terroir (how a particular region's climate, soil and aspects affect the taste of wine)? By studying the past seasons' cultivar trials, we celebrate the remarkable ability of potatoes to acclimatise to South Africa's diverse environments.

South Africa, being diverse in many respects, also boasts a rich diversity of potato varieties. Through our cultivar trials, potato seed companies can showcase how different varieties can thrive in specific regions. This not only equips our producers with the knowledge to make informed decisions, but also has the potential to benefit our consumers. As a nation of potato lovers, we aim to introduce South African consumers to the extensive range of potato varieties offered by our producers.

It's all in the taste

In line with this vision, the University of the Free State recently conducted a "slap chip" tasting session by their Department of Food Science, showing that some varieties are preferred based on taste. *CHIPS* will focus on this in a future article.

We aspire to collaborate further with such studies, bridging the gap between our potatoes and the appreciation they deserve from South Africans who share a genuine love for this versatile vegetable. Embracing diversity and promoting a wide range of potato varieties not only secures the future of our producers but also enriches the culinary experiences of our nation.

In conclusion, it is worth highlighting Potatoes SA's commitment to innovation in the potato industry. Our research and innovation focus is based on:

- Finding new uses for low-grade potatoes through a partnership with the Technology Innovation Agency and the University of Pretoria, to reduce waste and maximise potential.
- Leveraging data and digital technology to proactively manage risks and optimise productivity in potato farming.
- Improving soil by enhancing our understanding of soil ecology and implementing practices that promote soil health.
- Enhancing the quality and shelf life of potatoes by gaining a better understanding of how different cultivars perform in diverse conditions.

We appreciate the support of our dedicated workgroups and trial co-workers. Their contributions, collaboration and expertise have been instrumental in driving progress. With a focus on innovation, we are confident that the potato industry in South Africa will continue to thrive and meet the evolving needs of our producers and consumers.

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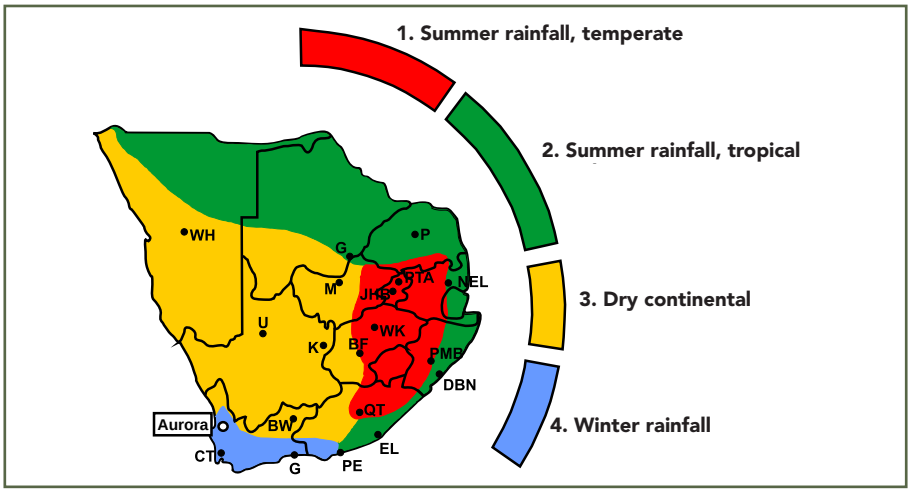
Sandveld cultivar trial under irrigation: Aurora 2022/2023

By Enrike Verster, Potatoes SA, Piet Brink, Sandveld working group, and Albert de Villiers, producer

The Sandveld production area produces approximately 10% (based on the 2019 harvest year) of the South African potato crop. The region supplies potatoes to the entire supply chain, from export and seed to table and processing potatoes. Table potatoes are mainly exported to Angola and seed potatoes to Mozambique. The area contributes approximately 14% to the processing industry. The main table and processing potatoes include Mondial, Sifra, Avalanche and FL2108 in both summer and winter plantings.

The cultivar trial was conducted on the farm Rietfontein in the Aurora region, at the foot of the western side of Piketberg. Rietfontein is located in a winter rainfall area (*Figure 1*) and has an annual average rainfall of 395 mm per year recorded over 21 years. The region has a Mediterranean climate with warm summers while the winters are cold and wet. Planting time for this area is unique as potatoes can be planted throughout the year. Most potatoes are, however, planted in February and June.

Figure 1: Location of Aurora in the Sandveld production area.



As with any crop, aspects such as temperature, availability of water as well as heat units, are all important factors that have a fundamental influence during the potato plant's growing period.

Trial design

The cultivar trial was carried out in sandy soil and laid out in a randomised block design with three replications per cultivar. *Table 1* contains additional technical information relating to the trial. *Table 2* includes the fertilisation programme for the past season. Soil samples were collected prior to planting to determine the soil nutrient status of the trial site (*Table 3*).

Differences in growing periods

The cultivar trial included cultivars with short and long growing periods. Hence, growing periods can influence the eventual yield of certain cultivars.

Table 1: Summary of technical information regarding the trial site and layout.

Farm	**Fisantevlug, Rietfontein**
Producer	Albert de Villiers
Planting date	28 September 2022
Harvest date	21 February 2023
Irrigation/dryland	Irrigation
Double or single rows	Double rows
Interrow spacing	0.75 m
In-row spacing	0.30 m
Trial site	17.5 m^2
Plant population	41 666 plante/ha

Table 2: Fertilisation programme.

	Nutritional value					
	N (kg/ha)	**P (kg/ha)**	**K (kg/ha)**	**Ca (kg/ha)**	**Mg (kg/ha)**	**S (kg/ha)**
Before planting	55.5	123.5	134.33	202	22.2	145.8
Week 1	26.39	4.14	27.43	0	1.55	0
Week 2	26.39	4.14	27.43	0	1.55	0
Week 3	26.39	4.14	27.43	0	1.55	0
Week 4	27.79	4.48	26.88	18.1	1.34	0
Week 5	18.19	6.272	37.63	0	1.88	0
Week 6	27.79	4.48	26.88	18.1	1.34	0
Week 7	18.19	6.272	37.63	0	1.88	0
Week 8	27.79	4.48	26.88	18.1	1.34	0
Week 9	14.62	5.04	30.24	0	1.51	0
Week 10	14.62	5.04	30.24	0	1.51	0
Week 11	14.62	5.04	30.24	0	1.51	0
Week 12	14.62	5.04	30.24	0	1.51	0
Total	**312.9**	**182.1**	**493.5**	**256.3**	**40.7**	**145.8**
3 tons gypsum/ha						

Table 3: Soil nutrient status of the trial site before planting.

pH (KCl)	Density (g/cm^3)	UIT H+ cmol(+)/kg	P Bray I (mg/kg)	K (mg/kg)	Na (mg/kg)	Ca (mg/kg)	Mg (mg/kg)	%Ca (%)	%Mg (%)	%K (%)	%Na (%)	CEC
5.2	1.697	0.18	7	11	3	96	16	57.2	16	3.5	1.3	0.8
Sand 96%				**Silt 2%**				**Clay 2%**				

The length of growing periods is subject to the nature of the season but is regarded as the amount of time that lapses from emergence to natural leaf senescence.

Table 4 illustrates how the growing periods differ among cultivars. *Table 4* also indicates the plant readiness of tubers at the time of the planting of the trial, as well as the plant population and haulm count, observed later in the growing period.

Classing and sorting

The evaluation of new cultivars such as those in the Aurora cultivar trial provides, among others, results regarding yield and marketing index. The marketing index of the cultivars in question is calculated by classing and sorting each cultivar according to quality and size group (for example, Class 1 Large or Class 2 Large medium). Prices are then accordingly compared to market prices as obtained during harvesting time.

The performance of new cultivars cannot be based on one specific season only, as climate can vary from one year to the next. Therefore, cultivars are preferably tested across several seasons.

Factors influencing growing periods

As with any crop, aspects such as temperature, the availability of water (whether through good irrigation scheduling or rainfall) as well as heat units, are all important factors that have a fundamental influence during the potato plant's growing period. Relevant daily weather data is obtained from a weather station at the trial site and a selected Agricultural Research Council's (ARC) weather station located as close as possible to the trial site, provides long-term data.

The 2022/23 season (*Figure 2*) saw below-average rainfall. Excessively high rainfall was recorded in the midst of the growing period (possibly during tuber filling).

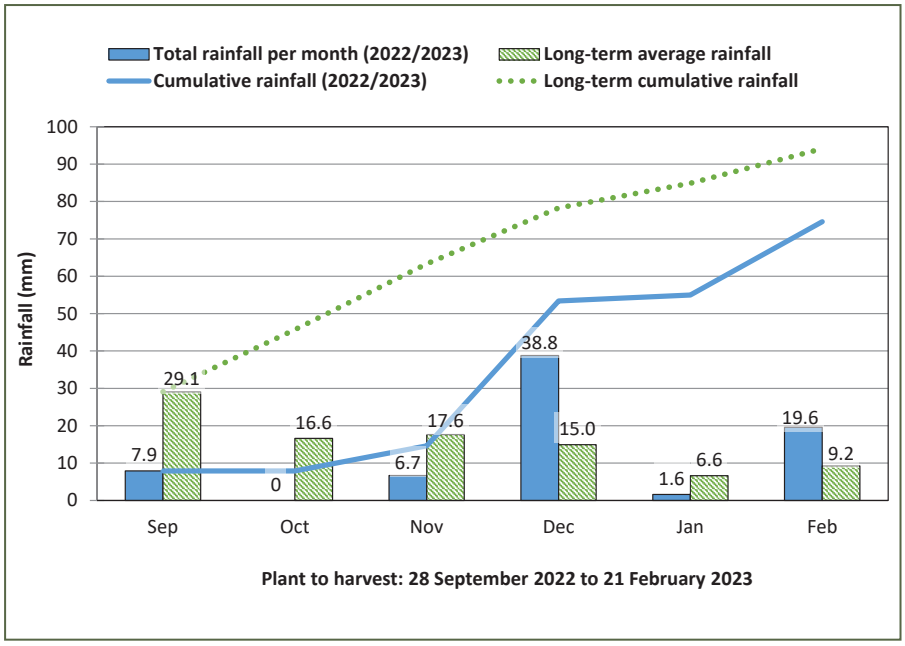
Figure 3 indicates minimum and maximum temperatures. The season was characterised by major fluctuations in maximum temperatures. During the growing season temperatures above 30°C were noted on 57 days, above 35°C on 14 days and above 40°C on one day. Temperatures were consistently high at the start and close to the end of the growing period.

Table 4: Cultivar characteristics relating to growing period, plant readiness, plant population (%) and haulm counts.

Agent	Cultivar	Growing period (days)[1]		Plant readiness[2]	Plant population (%)	Haulms per plant	Haulms per ha
GWK	11Z49A1	Medium to long	(100-120)	2	91	2.9	109 957
GWK	11Z55A5	Medium to long	(100-120)	2	93	2.6	100 748
WEE grow	Allison	Medium to long	(110-115)	4	85	3.9	138 135
GWK	Connect	Medium to long	(120)	2	91	4.3	162 208
First Potato Dynamics	CMK1			1	100	3.3	137 498
RSA	Foxy	Short to medium	(90-100)	4	100	5.3	222 423
First Potato Dynamics	Lady Alicia	Medium	(95-100)	2	98	2.4	97 998
GWK	Lanorma	Short	(80-90)	2	93	3.4	131 081
WEE grow	Mondial	Medium to long	(110-115)	2	91	4.2	160 672
GWK	Noya	Medium to long	(120)	3	75	3.1	97 691
PEPSICO	P3	Medium	(100)	3	97	3.8	154 514
First Potato Dynamics	Palace	Long	(110-115)	2	100	2.9	120 831
WEE grow	Panamera	Long	(120-125)	2	97	2.2	89 727
First Potato Dynamics	Prince	Long	(110-115)	1	30	1.8	22 500
WEE grow	Sababa	Medium to long	(110-115)	3	99	2.7	110 299
WEE grow	Sifra	Short to medium	(90-100)	2	97	4.0	161 762
First Potato Dynamics	Sound	Medium	(100)	2	93	4.1	159 254
WEE grow	Tyson	Short to medium	(90-100)	3	94	3.0	116 107
RSA	Valor	Medium	(100)	2	100	2.6	108 332

[1]General guidelines and categories (days from emergence to natural leaf senescence, depending on the season): Short = 70-90 days; Short to medium = 80-100 days; Medium = 90-110 days; Medium to long = 90-120 days; Long = 90-140 days.
[2]Plant readiness of tubers: 1 = Fresh; 2 = Slightly fresh; 3 = Plant ready; 4 = Slightly old; 5 = Old.

Figure 2: Rainfall (2022/23 season) as well as long-term average rainfall.



The collection of heat units during a growing period is an important factor in a potato plant's development. The trend of heat units available for the season's cultivar trial at Aurora followed more or less the same trend as the long-term average (*Figure 4*).

The yield index

Yield data collected during harvest day is subjected to statistical processing using the GenStat® program. The Tukey test of least significant differences (LSDs) was used to separate the mean. The cultivar effect during this specific trial (*Figure 5*) was statistically significant ($p<0.05$) and the coefficient of variation was well within limits (18.4%). These factors serve to indicate that

Table 5: Main reasons for downgrading

Kultivar	Loose skin	Nematodes	Powdery scab	Sunburn	Fusarium	Growth cracks	Malformation	Greening	Common scab	Sprouting	Moths
11Z49A1	x				x						
11Z55A5	x		x		x						
Allison			x		x						
Connect	x		x				x				
CMK1	x	x	x			x					
Foxy	x				x					x	x
Lady Alicia	x	x									
Lanorma			x		x						
Mondial	x			x	x					x	
Noya	x		x		x						x
P3	x				x			x			
Palace	x				x	x					
Panamera	x	x	xx		x						
Prince	x										
Sababa	x		x	x							x
Sifra	x		x								
Sound	x	x	x	x							
Tyson	x				x	x				x	
Valor	x								x		
<5% incidence				5-15% incidence				>15% incidence			

the trial was executed well and that the results are reliable.

The yield of each of the cultivars is divided by the trial average (the trial average of all the cultivars is taken as 100%). The yield of every cultivar is divided by the trial average (the trial average of all the cultivars is taken as 100%). This is used to determine a yield index and each cultivar's performance in terms of yield was then read as a percentage of the trial average.

The trial yield

The average yield of the trial for the 2022/23 season is 80.67 t/ha which is considerably lower than the previous five seasons' average of 106.3 t/ha. Allison, Valor, Sound, 11Z55A5, Palace, Sifra, Foxy, Mondial and 11Z49A1 produced the highest yields with no statistical difference in yield. Valor, Sound Allison and Palace

Table 6: Keeping quality of cultivars as observed six weeks after harvest.

Cultivar	Condition after six weeks	Observations
11Z49A1	Medium	Silver scab and wilted.
11Z55A5	Medium to good	Silver scab and wilted.
Allison	Good	Some sprouts.
Connect	Medium to good	Silver scab and wilted.
CMK1	Medium	Some rot and wilting.
Foxy	Medium	Wilting and sprouting.
Lady Alicia	Good	Some sprouting.
Lanorma	Good	Good and firm. Slight silver scab.
Mondial	Good	Good and firm. No sprouting.
Noya	Good	Firm and no sprouting.
P3	Undesired	Sprouting and rotten tubers.
Palace	Good	Some sprouting.
Panamera	Medium to undesired	A few rotten tubers, rest edible.
Prince	Medium	Poorly looking skin and wilted.
Sababa	Medium	Two rotten tubers; rest firm.
Sifra	Medium to good	Slightly wilted, but generally good.
Sound	Good	Some sprouting.
Tyson	Medium to good	Silver scab and wilted.
Valor	Medium to good	Firm, but slight silver scab.

Figure 3: Minimum and maximum temperatures (2022/23 season) as well as long-term temperatures.

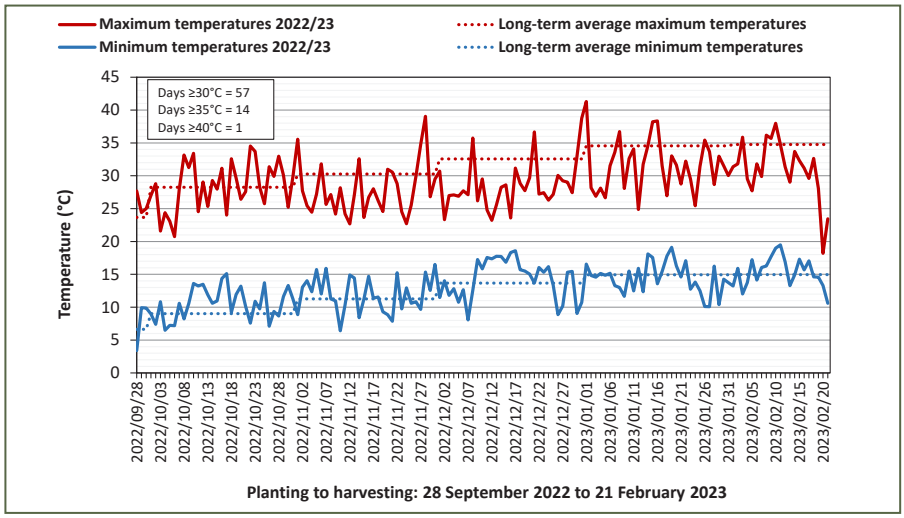
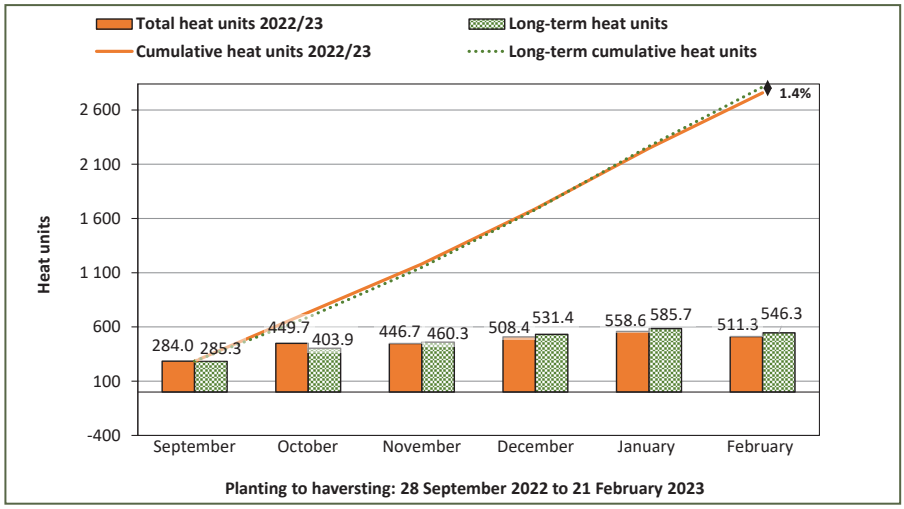
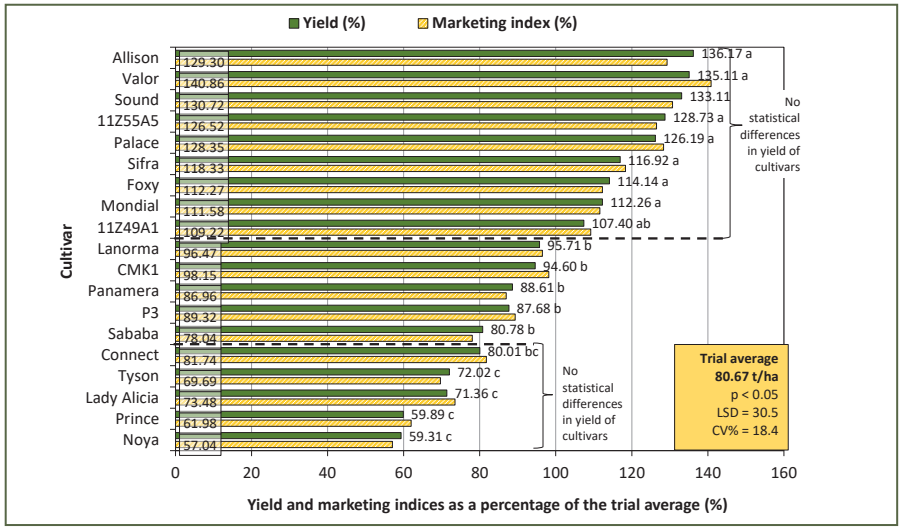


Figure 4: Heat units (2022/23 season) as well as long-term average heat units.



**Total heat units determined specifically for potatoes as a crop (threshold temperature = 5°C). Calculated from hourly data.*

Figure 5: Total yield per cultivar as a percentage of the trial average.



**Values followed by the same letter do not significantly differ from one another.*

The marketing index of the relevant cultivars is calculated by classing and sorting each cultivar according to quality and size group.

Figure 6: Size-group distribution of each cultivar in the trial.

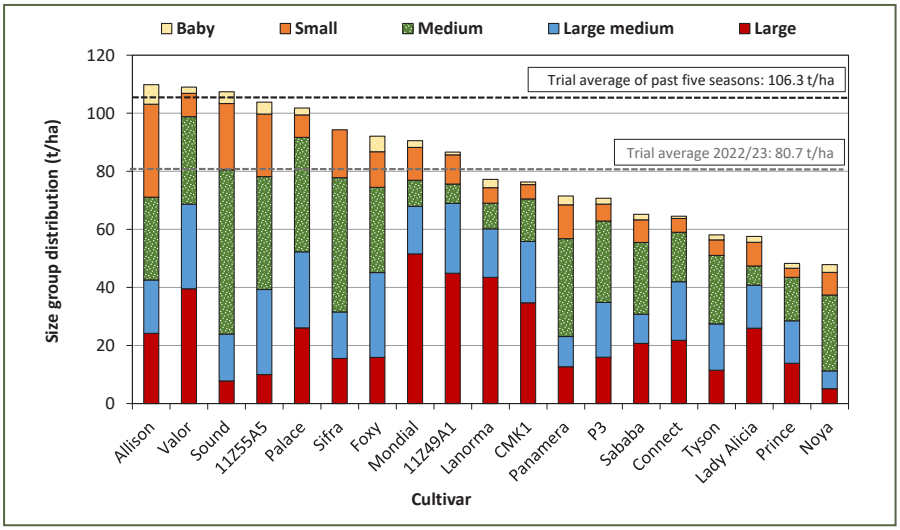


Figure 7: Grading of each cultivar in the trial.

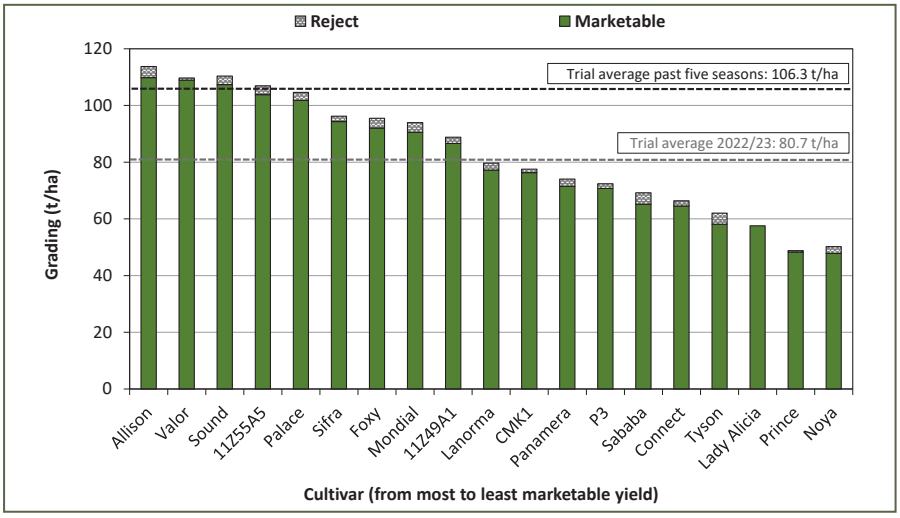
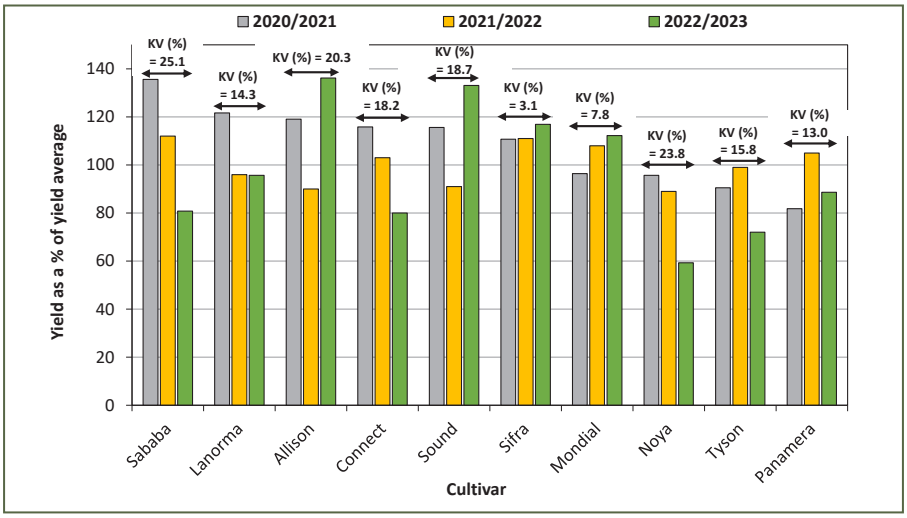


Figure 8: Performance of cultivars included in the trial for both years, expressed as a percentage of the trial average.



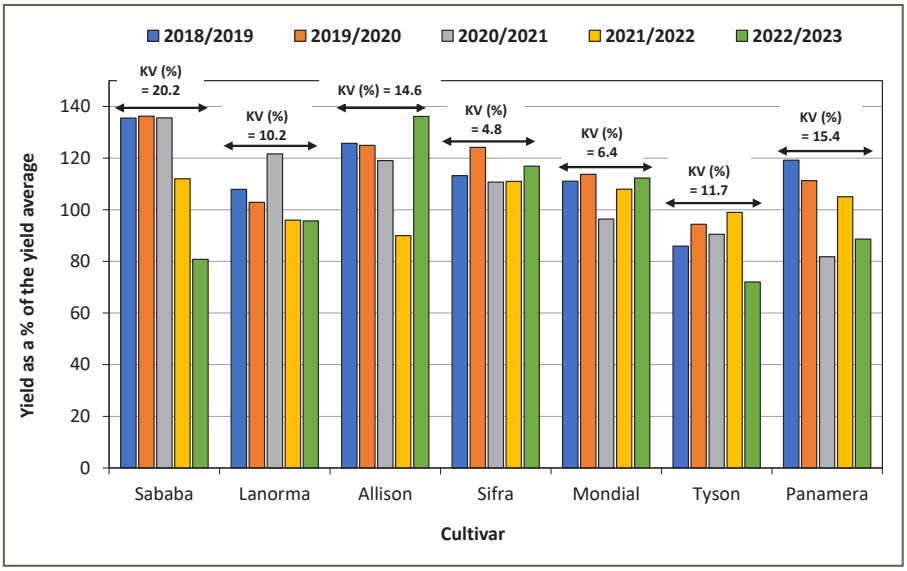
The coefficient of variation (CV %) is included in the graph: A value which essentially portrays the degree of difference in the performance of a specific cultivar over the number of years in question. The greater the CV % value, the greater the variation in the cultivar's performance over the number of years depicted on the graph.

Table 7: Processing characteristics of cultivars (executed by ARC-Roodeplaat).

Cultivar	Chip colour[1]	SG[2]	DM[3]	Brown
11Z49A1	46	1.0548	14.89	
11Z55A5	51	1.0592	15.83	
Allison	51	1.0607	16.15	
Connect	53	1.0652	17.09	x
CMK1	54	1.0639	16.81	
Foxy	45	1.0555	15.05	
Lady Alicia	49	1.0683	17.74	x
Lanorma	47	1.0575	15.46	x
Mondial	45	1.0548	14.89	
Noya	43	1.0653	17.12	
P3	53	1.0729	18.72	x
Palace	58	1.0685	17.80	x
Panamera	47	1.0658	17.22	x
Prince	58	1.0697	18.04	x
Sababa	46	1.0615	16.31	
Sifra	35	1.0508	14.05	
Sound	44	1.0668	17.42	
Tyson	45	1.0569	15.33	
Valor	43	1.0673	17.54	x

[1]Chip colour with a value of >50 and without defects is acceptable for the chip industry.
[2]Specific gravity of >1.075 is acceptable for the processing industry.
*[3]The percentage of dry matter is a calculated value: DM% = 24.182 + 211.04 * (SG-1.0988). The actual percentage value will differ slightly between varieties based on the calculating value.*

Figure 9: Performance of cultivars included in the trial for the past five years, expressed as a percentage of the trial average.



The coefficient of variation (CV %) is included in the graph: A value which essentially portrays the degree of difference in the performance of a specific cultivar over the number of years in question. The greater the CV % value, the greater the variation in the cultivar's performance over the number of years depicted on the graph.

obtained the best marketing index. A good marketing index is ascribed to a higher yield of Large potatoes and/or a good percentage of good quality potatoes.

Size group distribution and grading are crucial in ensuring an optimal, economically marketable yield (*Figures 6* and *7*). In this trial, potatoes were classed only as either marketable or non-marketable.

Seasonal factors

Just like the nature of the seasons, the performance of cultivars varies from one season to the next. This is simply because the climate is never the same in different seasons. Therefore it is important to consider consistent cultivar performance across several seasons. Variation of cultivars in the past three to five seasons is indicated in *Figures 8* and *9*. Currently, Sifra and Mondial are showing the least variation in this trial.

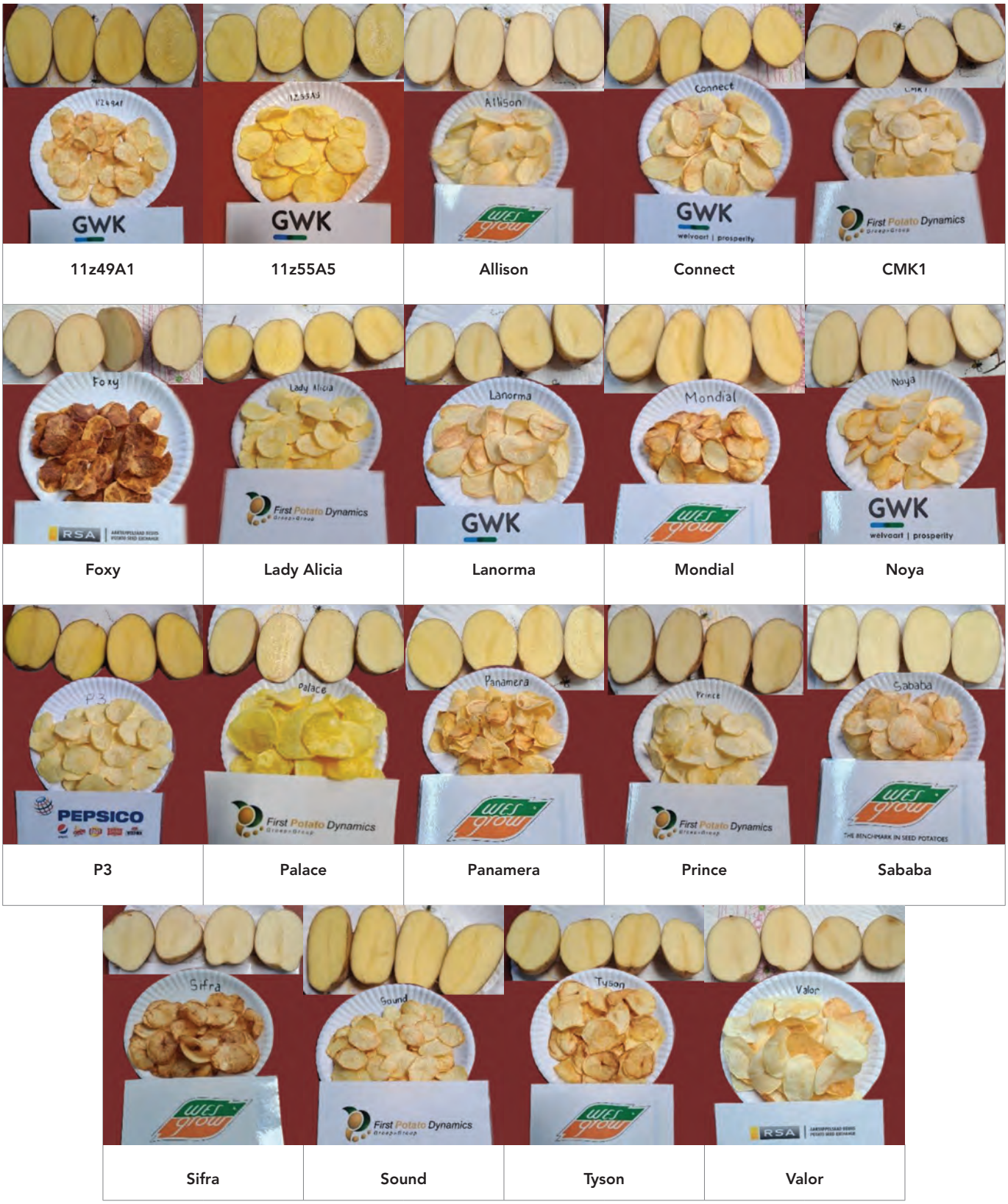
The main reasons for downgrading are indicated in *Table 5*. Fusarium, powder scab and loose skin were the main reasons for the downgrading of potatoes from marketable to rejected. Lasting quality was also informally evaluated six weeks after harvest. Comments regarding the condition of the cultivars are contained in *Table 6*.

Internal quality

Lastly, focussing on the internal quality of potatoes, processing characteristics can also be evaluated. To meet these processing requirements, cultivars must adhere to a chip colour standard of >50 and a specific gravity (SG) of ≥1.075 (*Table 7*). Several cultivars met the chip colour standard, but none met the correct SG requirement.

Internal quality was also investigated to determine whether the cultivars showed signs of hollow heart or brown spot. None of the cultivars exhibited hollow heart, but some did indicate brown spot (*Table 7*). *Table 8* indicates the specific cultivar's flesh colour after harvest, both uncooked and fried.

Table 8: Flesh colour and internal quality of the 2022/23 yield in Aurora.



11z49A1	11z55A5	Allison	Connect	CMK1
Foxy	Lady Alicia	Lanorma	Mondial	Noya
P3	Palace	Panamera	Prince	Sababa
Sifra	Sound	Tyson	Valor	

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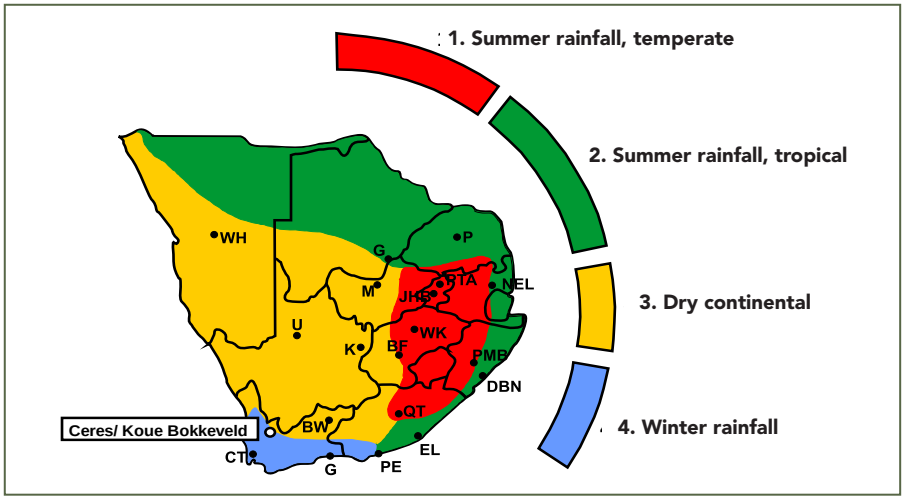
Ceres/Koue Bokkeveld cultivar trial under irrigation: Donkerbos in 2021/22

By Chantel du Raan, Potatoes SA

The Ceres production area produces approximately 1.4% (based on the 2020 harvest) of the overall potato production in South Africa. Planting in this region is conducted under irrigation, mainly for the production of table and processing potatoes (737 ha for the 2021 season), while 73 ha is planted for seed potato purposes. The main cultivars for table and processing potatoes include FL2108 (33%), Avalanche (20%) and Sifra (14%), while cultivars for seed potatoes include FL2108 (56%), FL2006 (30%) and Fasen (14%).

Figure 1: Location of Ceres/Koue Bokkeveld in the Western Cape production areas.



Trials were carried out at Donkerbos in the Koue Bokkeveld, which is a winter rainfall area with an annual average rainfall of 599 to 700 mm/year (*Figure 1*). As the area is located inland, the summers are hot whereas winters are very cold and wet with frequent snow on the surrounding mountains. The main planting period for the production area is between October and November. Plantings that are planted earlier or later have a higher risk of rain damage.

The trial site consisted of sandy soil and the trial was planted in a

Table 1: Summary of technical information regarding the trial site and layout.

Farm	**Donkerbos (865 m above sea level)**		
Planting date	4 November 2021		
Harvest date	6 April 2022		
Irrigation/dryland	Irrigation		
Double or single rows	Double rows		
Leaf senescence	Natural		
Interrow spacing	0.9 m		
Intrarow spacing	0.215 m staggered		
Trial site per unit	18m^2		
Population density	51 680 plants/ha		
Fertiliser programme			
	Nutritional value		
	N (kg/ha)	**P (kg/ha)**	**K (kg/ha)**
Total	**360**	**155**	**460**

Figure 2: Rainfall during the growing season (2021/22) as well as the long-term average rainfall.

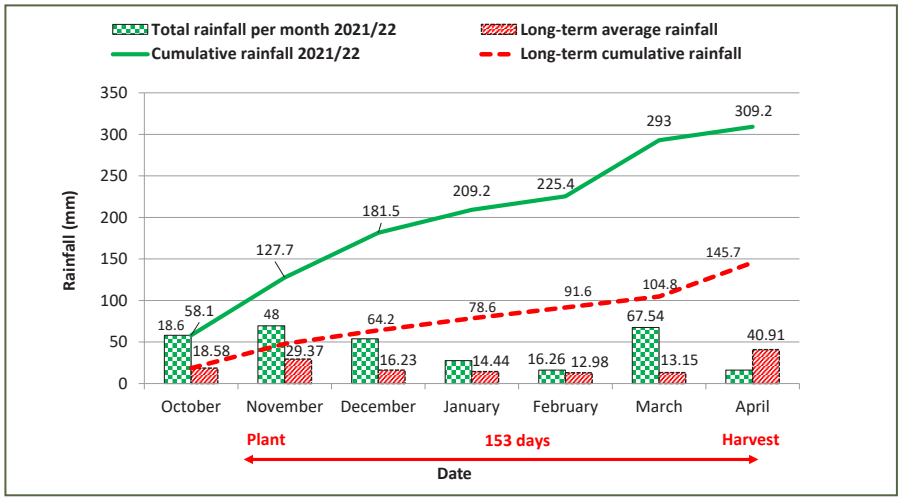
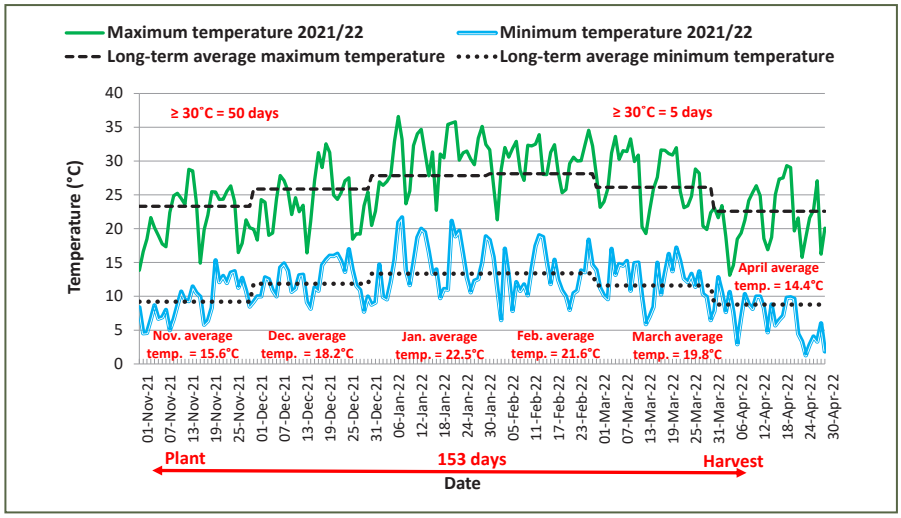


Figure 3: Minimum and maximum temperatures (°C) during the 2021/22 growing season as well as the long-term temperatures.



completely randomised block design with three replications per cultivar. More technical information regarding the trial site and layout is summarised in *Table 1*.

Growth periods

It is important to note that cultivar yields can be affected by growth periods. Growth periods are defined as the number of days from emergence to natural leaf senescence, depending on the season.

The exact timing of the five growth phases (shoot development, vegetative growth, tuber initiation, tuber filling and maturity) depends on the environment and management practices which vary between localities as well as cultivars due to, among others, the different growth periods. The cultivars, plant readiness of seed potatoes, population density (%) and haulm count of this trial are contained in *Table 2*.

Temperature, daylight length and water availability are the most important abiotic factors influencing the growth pattern, yield and quality of potatoes. To determine the adaptability of new cultivars to the Ceres/Koue Bokkeveld environment, it is important to take these factors into account when evaluating the performance of different cultivars. It is also important to evaluate cultivars for a number of seasons because climate varies between seasons.

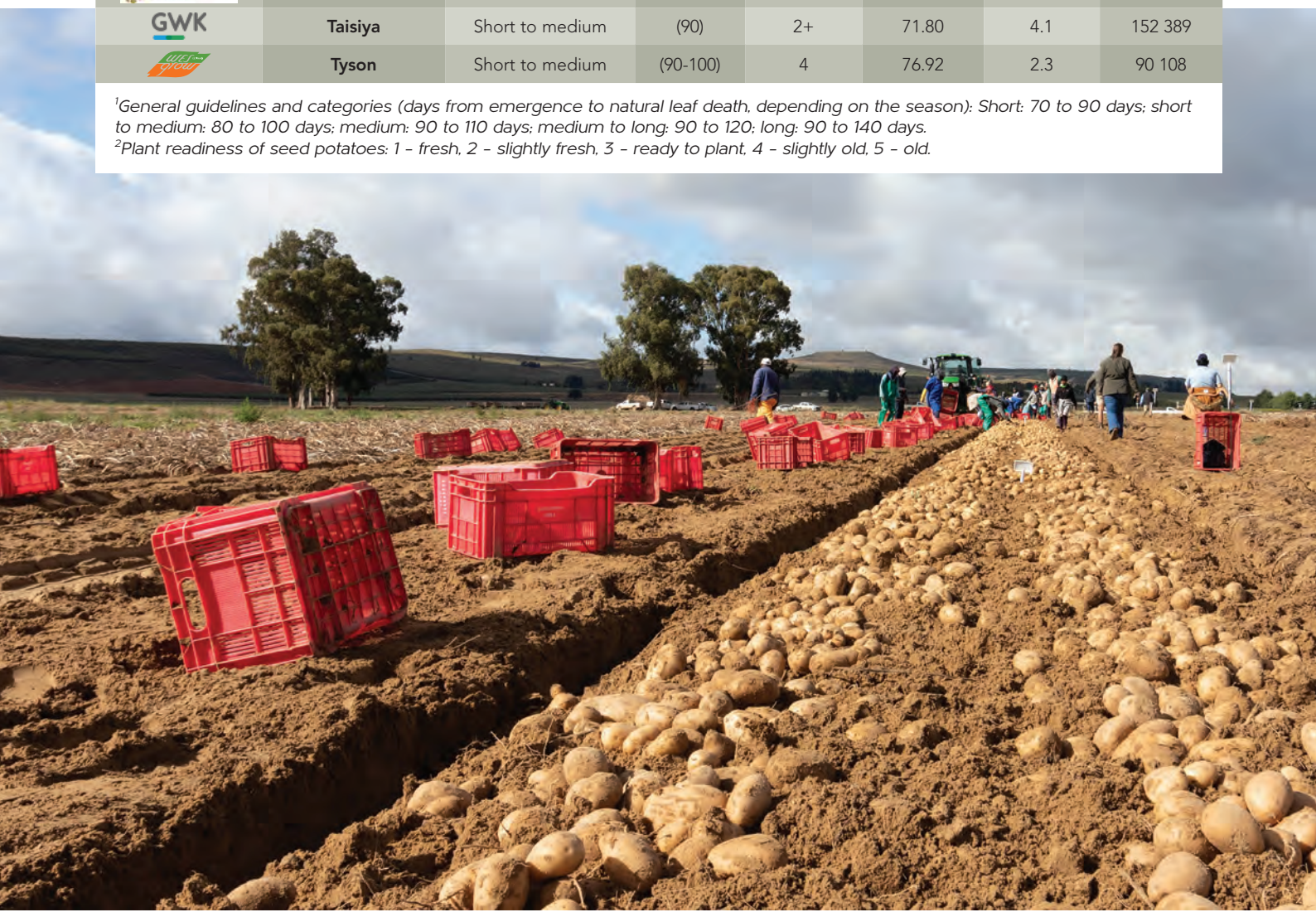
The daily weather data was obtained from a weather station located on the premises. It rained significantly more throughout the growing season compared to the long-term average. This large amount of rain caused the cumulative long-term data, which was consistently above average, to recover (309.2 mm), as can be seen in *Figure 2*.

The minimum and maximum temperatures (*Figure 3*) for the 2021/22 growing season followed the same pattern as previous years, the exception being that the maximum temperatures in November and December were lower than the long-term data. The minimum temperatures, on the

Table 2: Characteristics regarding growth period, plant readiness, population density (%) and haulm count for each cultivar in 2021/22.

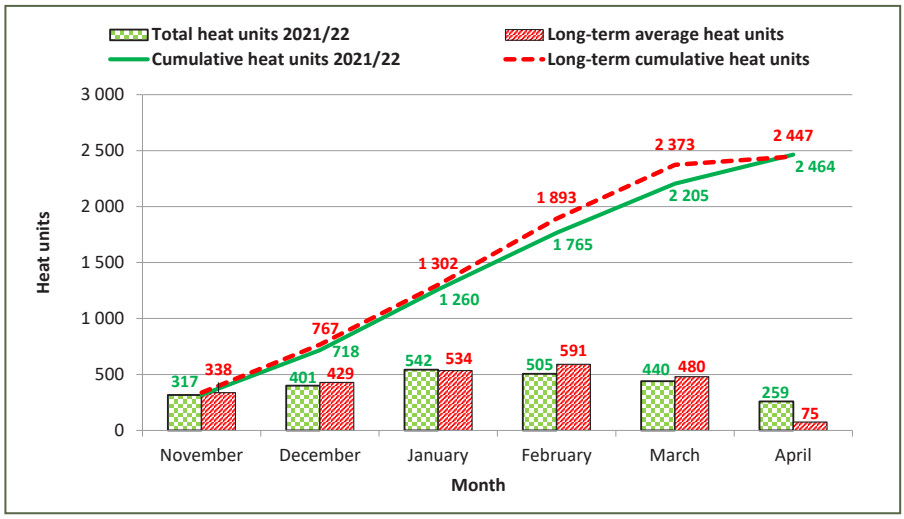
Agent	Cultivar	Growth period (days)[1]		Plant readiness[2]	Population density (%)	Haulms per plant	Haulms per ha
	Allison	Medium to long	(110-115)	2	82.05	5.2	219 971
	Alverstone Russet	Medium to long	(110-115)	3-	69.23	3.9	140 463
GWK	**Belmonda**	Short to medium	(100)	3+	71.79	4.2	155 040
GWK	**Connect**	Medium to long	(120)	3+	71.79	4.6	170 941
RSA	**Foxy**	Short to medium	(100-110)	3	79.49	4.5	185 517
GWK	**Lanorma**	Short	(80-90)	4	56.41	2.4	68 906
	Mondial	Medium to long	(110-115)	1	64.10	4.6	151 064
GWK	**Noya**	Medium to long	(120)	5	61.54	2.6	82 157
	Panamera	Long	(120-125)	2+	64.10	2.7	90 108
	Sababa	Medium to long	(110-115)	3	64.10	4.4	147 089
GWK	**7 Four 7**	Short	(80)	4	61.54	3.2	102 034
	Sifra	Short to medium	(90-100)	1	71.80	3.6	132 512
First Potato Dynamics	**Sound**	Medium	(100)	3	82.05	3.6	152 652
GWK	**Taisiya**	Short to medium	(90)	2+	71.80	4.1	152 389
	Tyson	Short to medium	(90-100)	4	76.92	2.3	90 108

[1]General guidelines and categories (days from emergence to natural leaf death, depending on the season): Short: 70 to 90 days; short to medium: 80 to 100 days; medium: 90 to 110 days; medium to long: 90 to 120; long: 90 to 140 days.
[2]Plant readiness of seed potatoes: 1 - fresh, 2 - slightly fresh, 3 - ready to plant, 4 - slightly old, 5 - old.



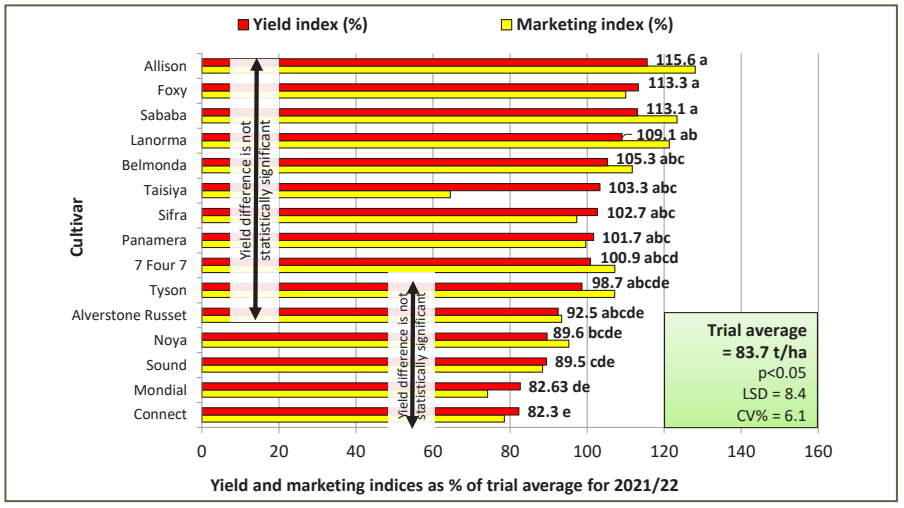
Trials were carried out at Donkerbos in the Koue Bokkeveld, a winter rainfall area with an annual average rainfall of 599 to 700 mm/year.

Figure 4: Heat units during the 2021/22 growing season as well as the long-term average heat units.



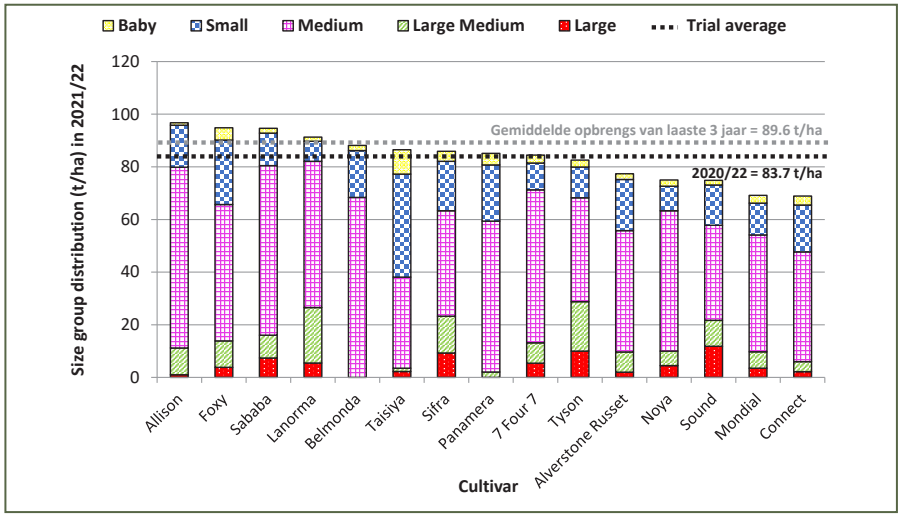
**Total heat units determined specifically for potatoes as a crop (threshold temperature = 5°C). Calculated from hourly data.*

Figure 5: Total yield and marketing indices per cultivar as a percentage of the trial average.



**Values followed by the same letter are not significantly different from one another.*

Figure 6: Size group distribution of each cultivar during final harvest.



**Size group distribution was performed on one replication.*

other hand, were slightly higher from December to March, compared to the long-term data. Significant fluctuating temperatures were also observed throughout the growing season. Temperatures were above 35°C for 50 days and above 30°C for five days.

Heat units

Heat units are also an important factor to consider since the development of the plant is based mainly on the collection thereof. It is therefore assumed that the plant must collect a certain number of heat units to complete a development phase.

The heat units for the 2021/22 growing season basically followed the same pattern as the long-term average heat units (*Figure 4*). At the end of the season, the relevant year's heat units for the growing season were 0.7% lower than the long-term cumulative heat units.

The yield data was statistically processed using the Gen-Stat® program and the mean was separated using the Tukey test of least significant differences (LSD). The cultivar effect during the 2021/22 trial (*Figure 5*) was statistically significant ($p<0.05$) in terms of yield, while the coefficient of variation (CV) was low (8.4%). This indicates that the trial was well executed and that the results are reliable.

The average yield for the 2021/22 season was 83.7 t/ha. During the 2021/22 trials (*Figure 5*), the cultivars Allison, Foxy, Sababa, Lanorma, Belmonda, Taisiya, Sifra, Panamera, 7 Four 7 and Tyson produced the highest yields. The cultivars Allison, Foxy, Sababa, Lanorma, Belmonda, Taisiya, Sifra, Panamera and 7 Four 7 produced higher yields than the trial average (83.7 t/ha).

In order to determine cultivar performance in terms of yield and quality, the yield, size group distribution and class were used to calculate a marketing index against the average market prices for the day in question. The yield, multiplied by the prevailing price which is determined by the size distribution

Table 3: Main reasons for downgrading during the 2021/22 Ceres/Koue Bokkeveld harvest.

Cultivar	Common scab	Enlarged lenticels	Greening	Growth cracks	Feathering	Malformation	Potato tuber moth	Regrowth	Silver scab and black dot
Allison	X	X			X				
Alverstone Russet	X	X			X		X		
Belmonda		X			X				
Connect		X			X	X			
Foxy	X	X			X	X		X	X
Lanorma		X							
Mondial	X	X		X	X				
Noya	X		X	X	X	X			
Panamera	X				X				
Sababa	X	X		X	X				
7 Four 7	X	X			X			X	
Sifra	X	X			X				
Sound	X			X	X				
Taisiya				X		XX	X		
Tyson	X	X			X				

Table 4: Processing characteristics of cultivars. (Performed by ARC-Roodeplaat)

Kultivar	Chip colour[1]	SG[2]	Dry material (%)[3]	Hollow heart	Brown spot
Allison	51	1.085	21.17	–	–
Alverstone Russet	57	1.087	21.77	–	–
Belmonda	52	1.088	21.81		–
Connect	51	1.090	22.22	–	–
Foxy	44	1.069	17.86	–	–
Lanorma	58	1.084	21.05	–	–
Mondial	53	1.080	20.16	–	–
Noya	57	1.095	23.29	–	–
Panamera	58	1.091	22.56	–	–
Sababa	49	1.081	20.45	–	–
7 Four 7	43	1.066	17.35	–	–
Sifra	45	1.078	19.79	–	–
Sound	55	1.081	20.43	–	–
Taisiya	41	1.075	19.24	–	–
Tyson	58	1.084	20.98	–	–
≥ Norm (acceptable for processing)			< Norm (unacceptable for processing)		

[1]Chip colour with value >50 and without defects is acceptable for the chip industry.
[2]Specific gravity of >1.075 is acceptable for the processing industry.
*[3]The percentage of dry matter is a calculated value: DM% = 24.182 + 211.04 * (SG-1.0988). The actual percentage value will vary slightly between varieties from this calculated value.*

The cultivars Allison, Foxy, Sababa, Lanorma, Belmonda, Taisiya, Sifra, Panamera and 7 Four 7 produced higher yields than the trial average (83.7 t/ha).

and grading, gives the marketing index (*Figure 5*).

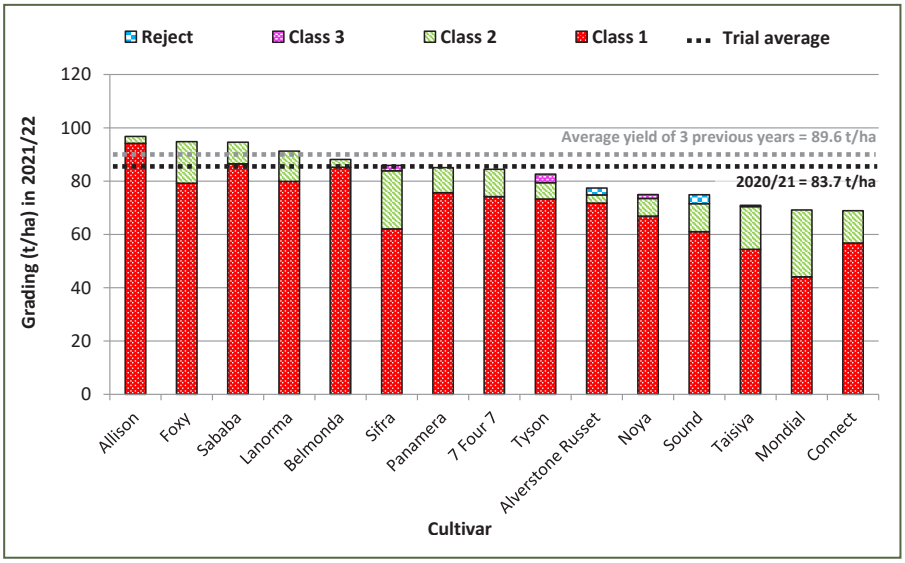
Allison, Foxy and Sababa excel

Allison, Foxy and Sababa achieved the highest marketing index as a result of a high percentage of Large tubers (*Figure 6*) and a Class 1 rating (*Figure 7*). Size distribution and grading are also used to grade potatoes and are therefore important factors to consider in order to ensure an optimal, economically marketable yield. The size group distribution is indicated in *Figure 6*, the grading of the yields in *Figure 7*, and the main reasons for the downgrading of the different cultivars in *Table 3*.

It is also important to take note of the cultivars' ability to perform consistently, regardless of climate fluctuations over time. *Figure 8* illustrates the three-year data for the cultivar trials in the Koue Bokkeveld/Ceres production area. The CV between the three years is indicated above each cultivar. The cultivars Sound, Allison and Mondial showed the least variation for the Ceres/Koue Bokkeveld area.

It is also important to focus on the internal quality of the

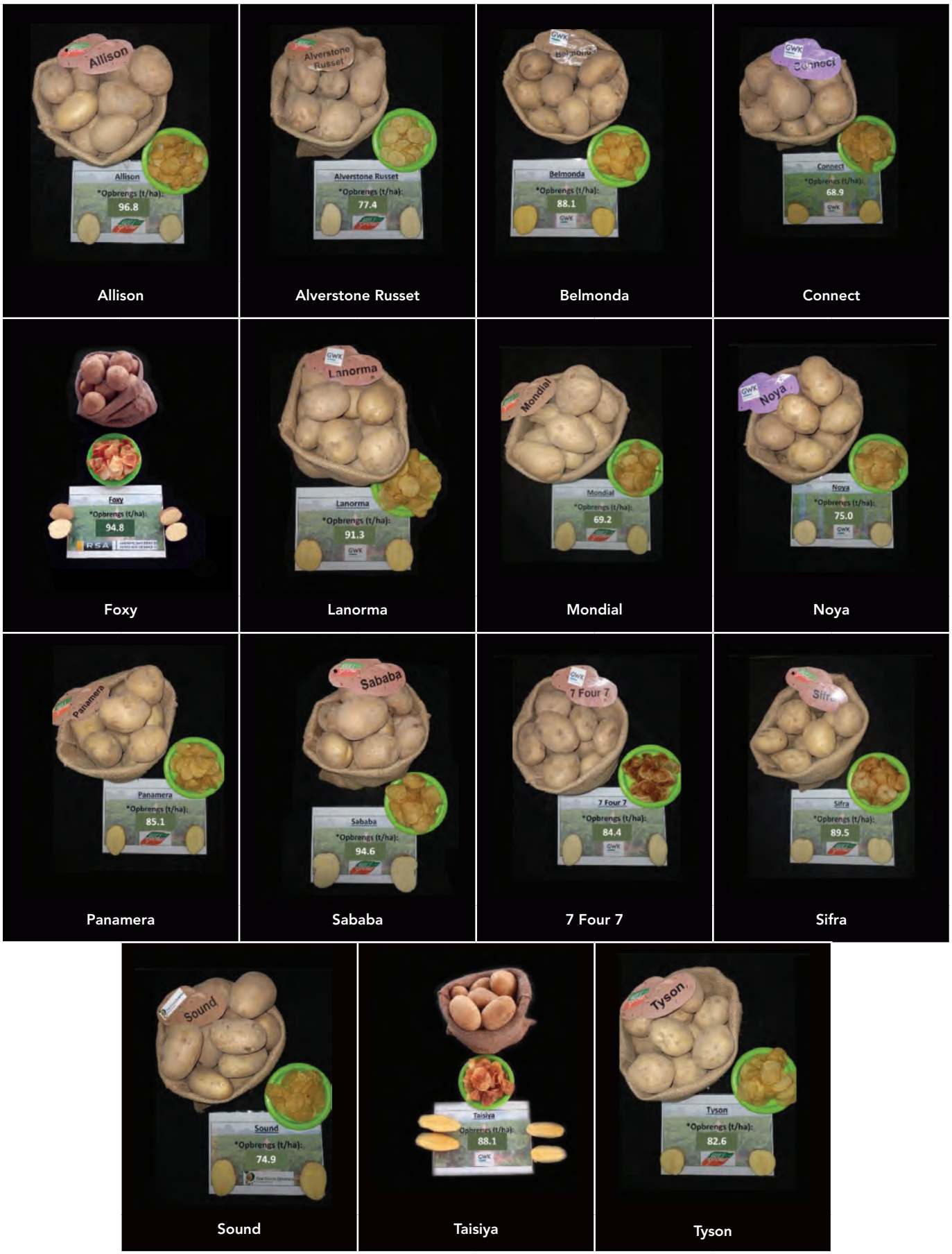
Figure 7: Grading of each cultivar during final harvest.



**Grading was performed on one replication.*

The trial consisted of sandy soil and was planted in a completely randomised block design with three replications per cultivar.

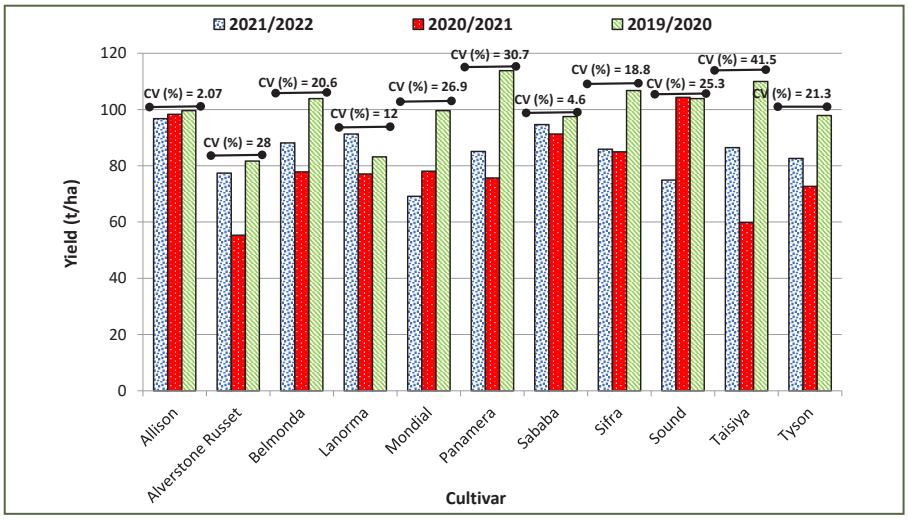
Table 5: Flesh colour and internal quality of the 2021/22 harvest in Ceres/Koue Bokkeveld.



product to ensure an economic, optimally marketable yield and therefore profitability. This includes important factors such as processing characteristics, specific gravity (SG) and internal defects (hollow heart, brown spot and vascular browning), which are summarised in *Table 4*.

During the 2021/22 growing season, all cultivars except Foxy, Sababa, 7 Four 7, Sifra and Taisiya met the chip colour standard of >50. All cultivars except Foxy and 7 Four 7 met the SG of ≥1.075 for processing. In the case of internal defects, no cultivar exhibited hollow heart or brown spot. Each cultivar's characteristics can be seen in *Table 5*.

Figure 8: Performance of cultivars over three years expressed as a percentage of the trial average.



Many thanks to our collaborators: Terence Brown and Soreen Gouws from Potatoes SA; Inus Oosthuizen, Ceres working group chairperson and Donkerbos; Hano Dreyer, Gerard Mostert and Bennie Visagie, Donkerbos; Van Zyl du Toit, Wesgrow; Martin Smith, GWK; Daan du Plessis, First Potato Dynamics; and Pierre van der Westhuizen, RSA Potato Seed Exchange.

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Ceres/Koue Bokkeveld cultivar trial under irrigation: Donkerbos 2022/23

By Enrike Verster, Potatoes SA

The Ceres production region produces approximately 1.4% of the entire South African potato crop. The region cultivates mainly table and processing potatoes (609 ha in the 2022 season) under irrigation.

Approximately 53% of the region's potatoes are planted for processing purposes (FL2108). The main cultivars aimed at the table usage market include Sifra, Lanorma and Avalanche. The cultivar trial was conducted at Donkerbos in the Koue Bokkeveld which is located the winter rainfall area (*Figure 1*).

Figure 1: Location of Ceres/Koue Bokkeveld in one of the Western Cape's production areas.

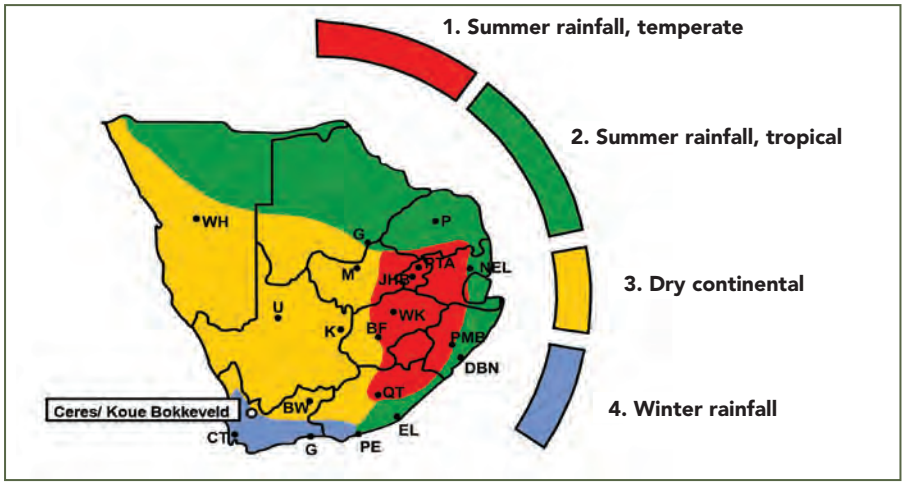


Table 1: Summary of technical information relating to the trial site and layout.

Farm	**Donkerbos (865 m above sea level)**		
Co-workers	Gerard Mostert, Hano Dreyer, Bennie Visagie, Daniël Victor, Inus Oosthuizen		
Planting date	26 October 2022		
Harvest date	29 March 2023		
Irrigation/dryland	Irrigation		
Double or single rows	Double rows		
Leaf senescence	Natural		
Inter-row spacing	0.9 m		
In-row spacing	0.215 m staggered		
Trial site	18 m^2		
Plant population	51 680 plants/ha		
Fertilisation programme	**Nutritional value**		
	N (kg/ha)	**P (kg/ha)**	**K (kg/ha)**
Total	**360**	**155**	**460**

Table 2: Soil nutrient status of the trial site before planting.

pH (KCl)	Density (g/cm^3)	C	P	K	Ca	Mg	Na	Cu	Zn	Mn	B
		%	Bray I (mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
6.2	1.107	0.20	81	39	359	48	17	2.36	6.89	7.8	0.48

Over the past 21 years an annual average rainfall of 569 mm was recorded for the area. The region is characterised by warm summers and very cold and wet winters due to regular snowfall on the surrounding mountains. The main planting time in this area is between October and November. Earlier or later plantings run the risk of rain damage.

The cultivar trial location consists of sandy soil and was laid out in a randomised block design with three replications per cultivar. *Table 1* contains additional technical information relating to the trial. Soil samples were collected prior to planting to determine the soil nutrient status of the trial site (*Table 2*).

Differences in growing periods

The cultivar trial included cultivars with short and long growing periods. Hence, growing periods can influence the eventual yield of certain cultivars. While the length of growing periods is subject to the nature of the season, a growing period is regarded as the amount of time that lapses from emergence to natural leaf senescence.

Table 3 illustrates how the growing periods differ among cultivars. *Table 3* also indicates the plant readiness of tubers at the time of the planting of the trial, as well as the plant population and haulm count observed later in the growing period.

Cultivar performance and yield

The evaluation of new cultivars such as those in the Ceres cultivar trial, delivers results regarding yield and marketing index. The marketing index of the cultivars in question is calculated by classing and sorting every cultivar according to quality and size group (for example, Class 1 Large or Class 2 Large medium). Similar price comparisons are then made to market prices obtained at harvest time. The performance of new cultivars cannot be based on one specific season only, as climate can vary from one year to the next. Therefore, cultivars are preferably tested across a number of seasons.

Seasonal aspects

As with any crop, aspects such as temperature, availability of water (whether good irrigation scheduling or rainfall) as well as heat units are all important factors that have a fundamental influence during the potato plant's growing period. These factors are therefore taken into consideration when the performance of a cultivar is evaluated.

Figure 2: Rainfall (2022/23 season) as well as long-term average rainfall.

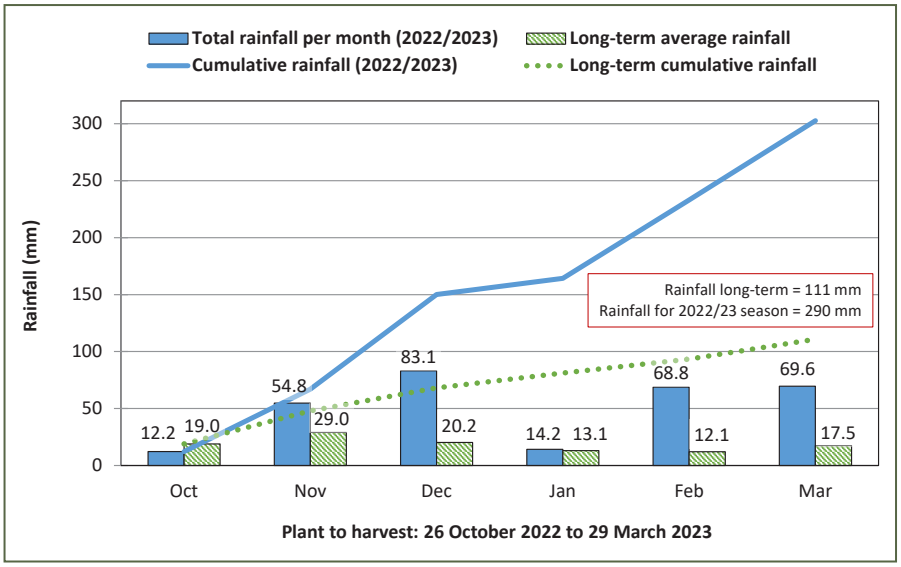
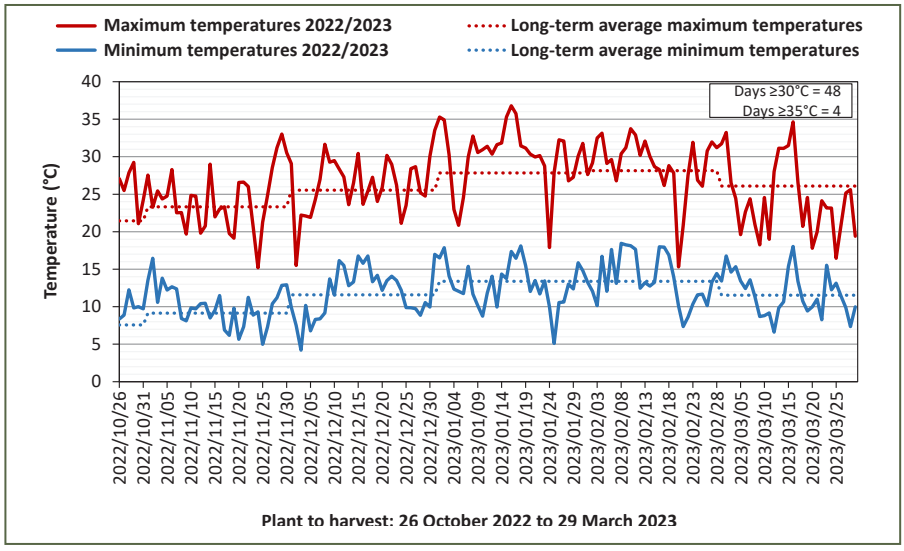


Table 3: Cultivar characteristics relating to growing period, plant readiness, plant population (%) and haulm counts.

Agent	Cultivar	Growing period (days)[1]		Plant readiness[2]	Plant population (%)	Haulms per plant	Haulms per ha
GWK	11Z49A1	Medium	(100)	2	100%	3.5	180 880
GWK	11Z55A5	Medium	(100)	2	95%	2.9	142 378
Well grow	Allison	Medium to long	(120)	3	100%	4.1	211 888
Well grow	Alverstone Russet	Medium to long	(100)	2	100%	3.7	191 216
GWK	Amany	Medium to long	(110)	3	100%	2.4	124 032
First Potato Dynamics	CMK2012	Long	(120)	3	100%	4.3	222 224
First Potato Dynamics	CMK2015	Long	(120)	3	100%	4.1	211 888
RSA	Foxy	Short to medium	(90-100)	2	100%	4.1	211 888
GWK	Kelly	Long	(120)	3	100%	3.8	196 384
First Potato Dynamics	Lady Alicia	Medium	(95-100)	2	100%	3.9	201 552
GWK	Lanorma	Short	(80-90)	3	97%	3.4	170 441
GWK	Lilly	Medium	(100)	3	97%	5.4	270 700
Well grow	Mondial	Short to medium	(95-100)	3	99%	4.0	204 653
GWK	Noya	Short	(80-90)	2	82%	2.7	114 420
First Potato Dynamics	Palace	Long	(110-115)	3	97%	3.5	175 457
Well grow	Panamera	Short to medium	(95-100)	4	100%	1.9	98 192
First Potato Dynamics	Prince	Long	(110-115)	3	95%	3.2	157 107
Well grow	Sababa	Medium to long	(110-115)	2	73%	3.1	116 952
Well grow	Sifra	Short to medium	(90-100)	3	100%	3.7	191 216
First Potato Dynamics	Sound	Medium	(95-100)	3	82%	2.7	114 420

[1]General guidelines and categories (days from emergence to natural leaf senescence, depending on the season): Short = 70-90 days; Short to medium = 80-100 days; Medium = 90-110 days; Medium to long = 90-120 days; Long = 90-140 days.
[2]Plant readiness of tubers: 1 = Fresh; 2 = Slightly fresh; 3 = Plant ready; 4 = Slightly old; 5 = Old.

Figure 3: Minimum and maximum temperatures (2022/23 season) as well as long-term temperatures.

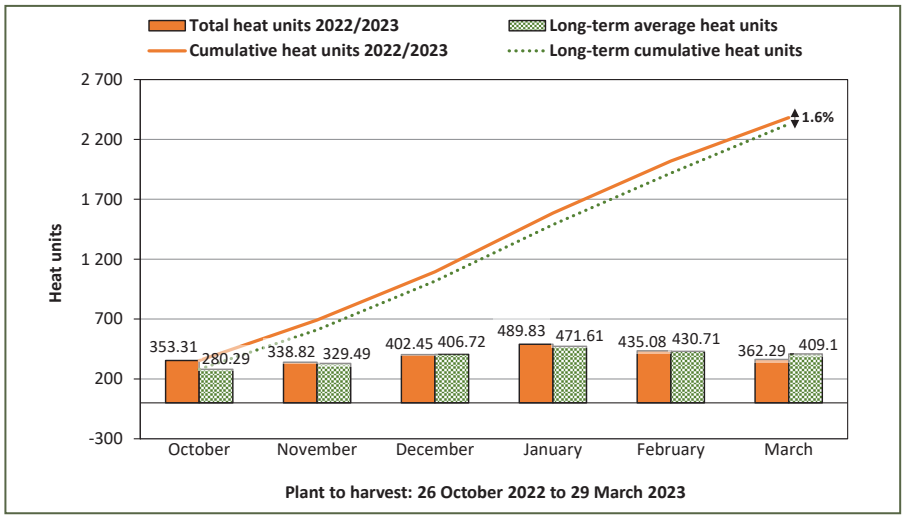


Relevant daily and long-term weather data is obtained from a nearby weather station that is located at the trial site and a selected Agricultural Research Council (ARC) weather station located as close as possible to the trial site.

The 2022/23 season (*Figure 2*) was characterised by above-average rainfall. Excessively high rainfall was recorded during the later stages of the growing period as well as during tuber initiation.

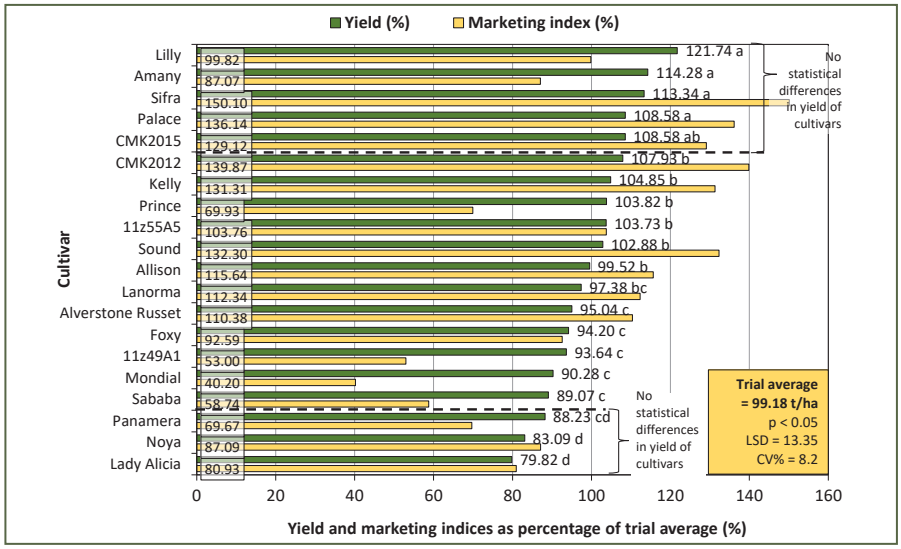
Figure 3 contains minimum and maximum temperatures. The season in question was characterised by major fluctuations in maximum temperatures. Temperatures above 30°C were noted on 48 days

Figure 4: Heat units (2021/22 season) as well as long-term average heat units.



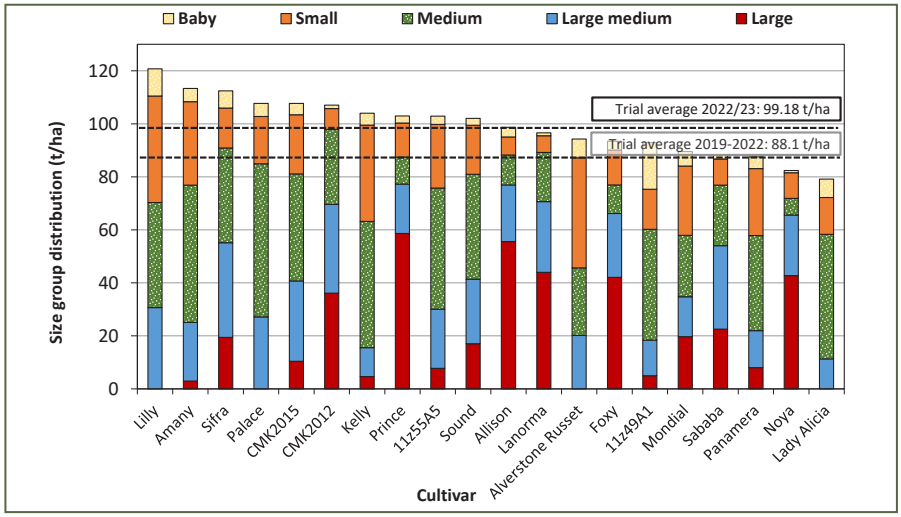
**Total heat units determined specifically for potatoes as a crop (threshold temperature = 5°C). Calculated from hourly data.*

Figure 5: Total yield per cultivar as a percentage of the trial average.



**Values followed by the same letter do not differ significantly from one another.*

Figure 6: Size group distribution of each cultivar in the trial.



and temperatures above 35°C were noted on four days.

The collection of heat units during a growing period is an important aspect of the development of a potato plant. The trend of heat units available for the season's cultivar trial at Donkerbos consistently remained above the long-term data trend for heat despite the above-average rainfall (*Figure 4*).

Yield data collected during harvest day is subjected to statistical processing using the GenStat® program. The Tukey test of least significant differences (LSDs) is used to separate the average. The cultivar effect during this specific trial (*Figure 5*) was statistically significant ($p<0.05$) while the coefficient of variation was well within limits (13.35%). These factors serve to indicate that the trial was very well executed. Hence, the results are reliable.

Yields and marketing index

The yield of each of the cultivars is divided by the trial average (the trial average of all the cultivars is taken as 100%). This is used to determine a yield index, with each cultivar's performance in terms of yield then read as a percentage of the trial average.

The average yield of each of the trial for the 2022/23-season is 99.18 t/ha - better than the previous four seasons' average of 88.1 t/ha. Lilly, Amany, Sifra, Palace and CMK2015 delivered the best yields with no statistical difference in the yield. Sifra, CMK2012 and Palace obtained the best marketing index. A good marketing index is ascribed to a higher yield of Large potatoes and/or a good percentage that are of good quality. Size group distribution and grading are indispensable when studying a cultivar's marketability (*Figures 6* and *7*).

Just like the nature of the seasons, the performance of cultivars varies from one season to the next. This is simply because the climate is never the same in different seasons. Therefore, it is important to consider

Table 4: Main reasons for downgrading.

Cultivar	Common scab	Malformation	Insects	Growth cracks	Silver scab & black spot	Stem-end rot
11Z49A1	x			x	x	x
11Z55A5	x		x	x	x	
Allison	x		x	x		
Alverstone Russet	x				x	
Amany	x	x		x		
Belmonda						
CMK2012	x					x
CMK2015	x					x
Foxy	x			x	x	
Kelly	x					
Lady Alicia	x				x	
Lanorma	x				x	
Lilly	x			x	x	
Mondial	x			x	x	
Noya	x				x	x
Palace	x				x	
Panamera	x	x		x	x	
Prince		x	x	x	x	
Sababa	x	x	x	x	x	
Sifra	x		x	x		
Sound	x	x		x	x	

Table 5: Processing characteristics of cultivars.

Cultivar	SG[1]	Hollow heart	Brown fleck
11z49A1	1.070		
11z55A5	1.070		
Allison	1.070		
Alverstone Russet	1.080		
Amany	1.075		
CMK2012	1.080		
CMK2015	1.080		
Foxy	1.065	x	x
Kelly	1.079		
Lady Alicia	1.086		
Lanorma	1.070		
Lilly	1.065		
Mondial	1.068	x	
Noya	1.073		
Palace	1.080		
Panamera	1.075		
Prince	1.070		
Sababa	1.062		
Sifra	1.074		
Sound	1.067		

[1]*Specific gravity of >1.075 is acceptable for the processing industry.*

The most prominent cultivars used in the area's main harvest are Lilly, Amany, Sifra, Palace and CMK2015.

consistent cultivar performance across a number of seasons. Variation of cultivars over the last three seasons are indicated in *Figure 8*.

Quality and downgrading

The main reasons for downgrading are indicated in *Table 4*. Common scab, growth cracks, silver scab and black dot were the main reasons for downgrading of potatoes to Class 2 and 3.

Lastly, when considering the internal quality of potatoes, an

Figure 7: Grading of each cultivar in the trial.

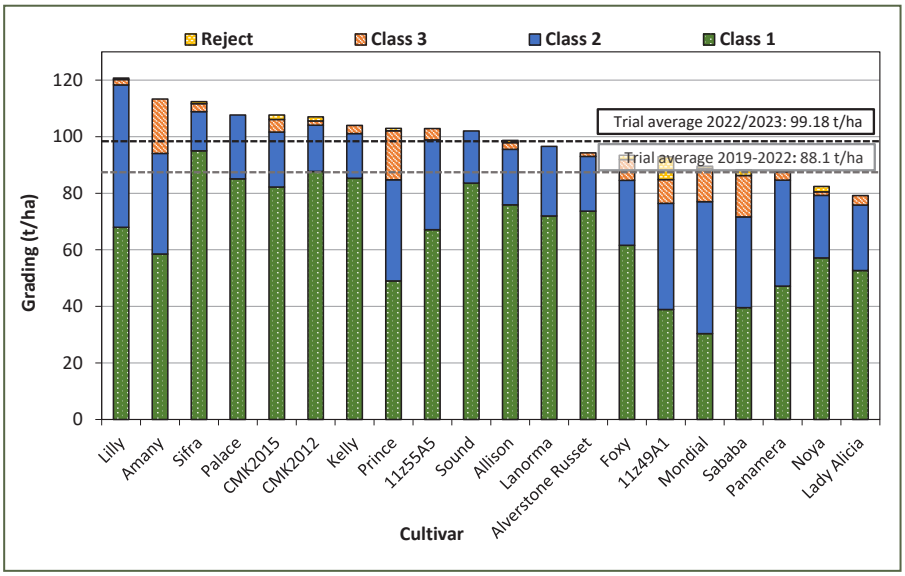
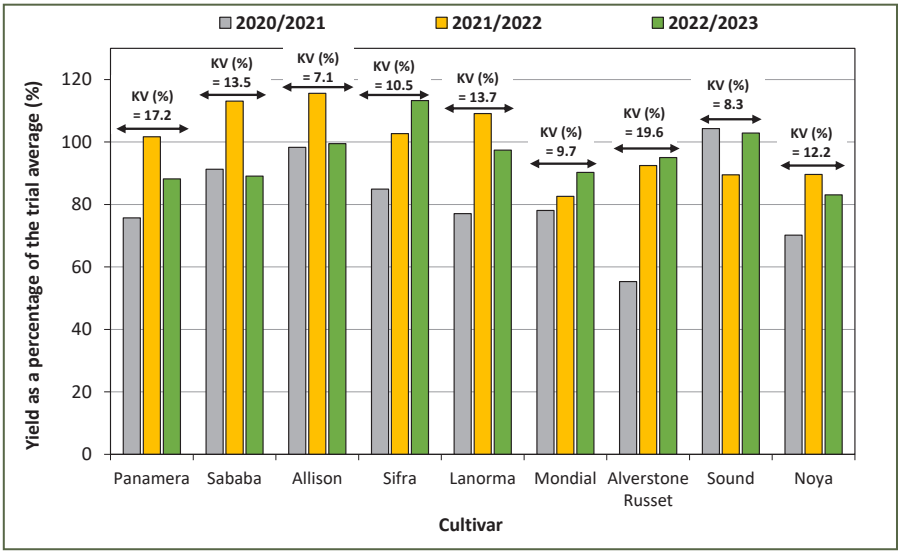


Figure 8: Performance of cultivars included in the trial for both years, expressed as a percentage of the trial average.



Coefficient of variation (CV %) is included in the graph: A value which essentially portrays the degree of difference in performance of a specific cultivar over the number of years in question. The greater the CV % value, the greater the variation in the cultivar's performance over the number of years depicted on the graph.

Table 6: Flesh colour and internal quality of the 2022/23 Ceres/ Koue Bokkeveld yield.

11z49A1

11z55A5

Allison

Alverstone Russet

Amany

CMK2012

CMK2015

Foxy

Kelly

Lady Alicia

Lanorma

Lilly

Mondial

Noya

Palace

Panamera

Prince

Sababa

Sifra

Sound

evaluation can also be done of its processing properties. To meet these processing properties, cultivars must meet a chip colour standard of >50 and a specific gravity (SG) of ≥1.075 (*Table 5*). Several cultivars met the SG standard. Internal quality is also investigated to estimate if the involved cultivars show signs of hollow heart or brown fleck. *Table 6* indicates the specific cultivar's flesh colour and internal quality.

Special thanks to Donkerbos and all involved individuals, the Ceres work group and Chantel du Raan and PJ Nell (Potatoes SA).
For more information, contact Enrike Verster at enrike@potatoes.co.za.

Northern Cape cultivar trial under irrigation at Douglas in 2022

By André Prins, GWK, and Herman Haak and Anjé Erasmus, Potatoes SA

The Northern Cape is a potato production region where 4% of the country's annual fresh produce market share is produced by 22 farmers on 1 796 ha. Approximately 76% of this region's potato production comprises seed potato production. Lanorma, Sifra and Tyson are the most prominent cultivars utilised for commercial production in this region.

Douglas is situated in a dry continental area (*Figure 1*) with an average annual rainfall of approximately 200 mm over the past six years. Winters are cold with frequent frost, while summers tend to become very hot.

The trial site consisted of sandy loam soil and the trial was planted in a randomised block design with four replications per cultivar. Further technical information regarding the trial site and layout is summarised in *Table 1*. Soil samples were taken before planting to determine the soil nutrient status of the trial site (*Table 2*).

Table 1: Summary of technical information regarding the trial site and layout.

Farm	**Landzicht Boerdery**		
Producer	Jan Steenkamp		
Planting date	26 January 2022		
Harvest date	9 June 2022		
Irrigation/dryland	Irrigation		
Double or single rows	Double rows		
Leaf senescence	Natural		
Interrow spacing	0.9 m		
Trial site	18 m^2		
Plant density	44 444 plants/ha		
Seed potato size	250 count (average 100 g)		
	Fertiliser programme		
	Nutritional value		
	N (kg/ha)	**P (kg/ha)**	**K (kg/ha)**
Total	**220**	**185**	**216**

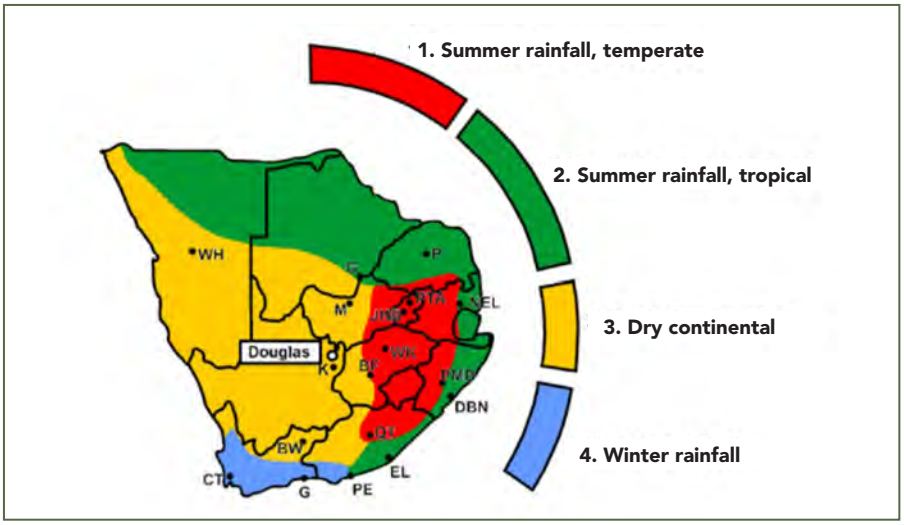
Growth periods

Both short and long growth period cultivars were included in the cultivar trial, meaning growth periods can therefore affect ultimate yield. Growth periods are defined as the number of days from emergence to natural leaf senescence, depending on the season.

A potato plant's lifetime is divided into five growth phases, namely sprout development, vegetative growth, tuber initiation, tuber filling and maturity. *Table 3* details how these growth periods differ among cultivars. Environmental factors and management practices also influence the different growth phases and their commencement.

Population density and number of haulms affect tuber size and yield. The number of eyes per tuber is cultivar-dependent and determines the number of sprouts produced per tuber. In this regard, the plant readiness of seed potatoes is very important, as improved plant readiness usually causes seed potatoes to sprout properly. Plant readiness of seed potatoes at the time of planting, as well as population

Figure 1: Location of Douglas in the Northern Cape production area.



density (%) and haulm count observed later in the growth period are also indicated in *Table 2*.

Class 1 determines marketing index

The evaluation of new cultivars as in the case of the Douglas cultivar trial provides results regarding, among others, yield and marketing indices. The marketing index of the relevant cultivars is calculated by classing and sorting each cultivar according to quality and size groups (for example Class 1 Large or Class 2 Large Medium).

Table 2: Soil nutrition status of trial site before planting.

Gross density (g/cm^{-3})	pH (KCl)	P-Bray I					% van CEC[1]			
		P	K	Ca	Mg	Na	K	Ca	Mg	Na
		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	%	%	%	%
1 540	5.9	13	192	460	160	15	11.8	55.2	31.5	1.5

Clay (%)	Silt (%)	Sand (%)
2	4	94

[1]*CEC = Cation exchange capacity.*

Figure 2: Rainfall for the 2022 season as well as the long-term average.

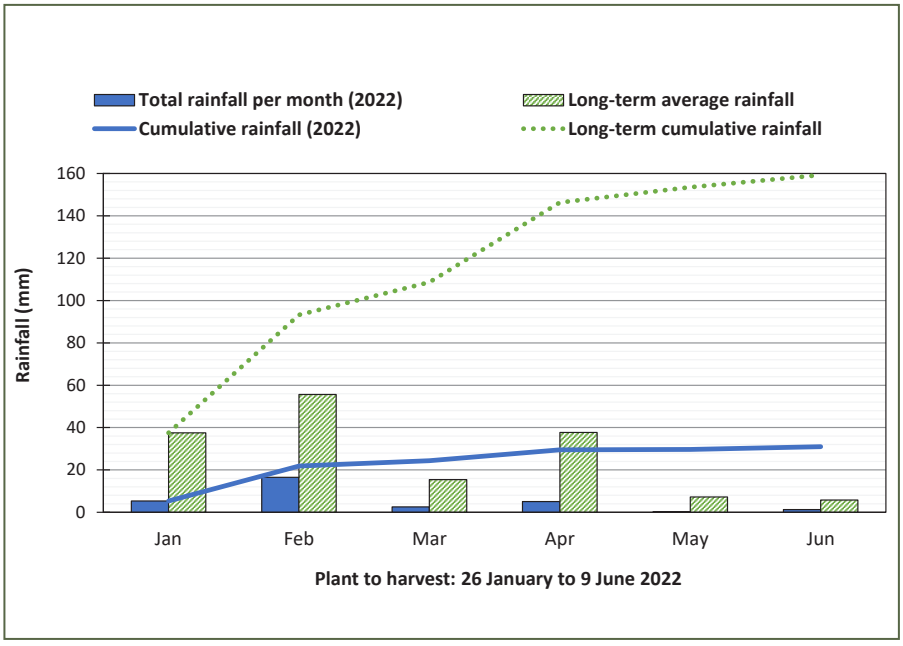
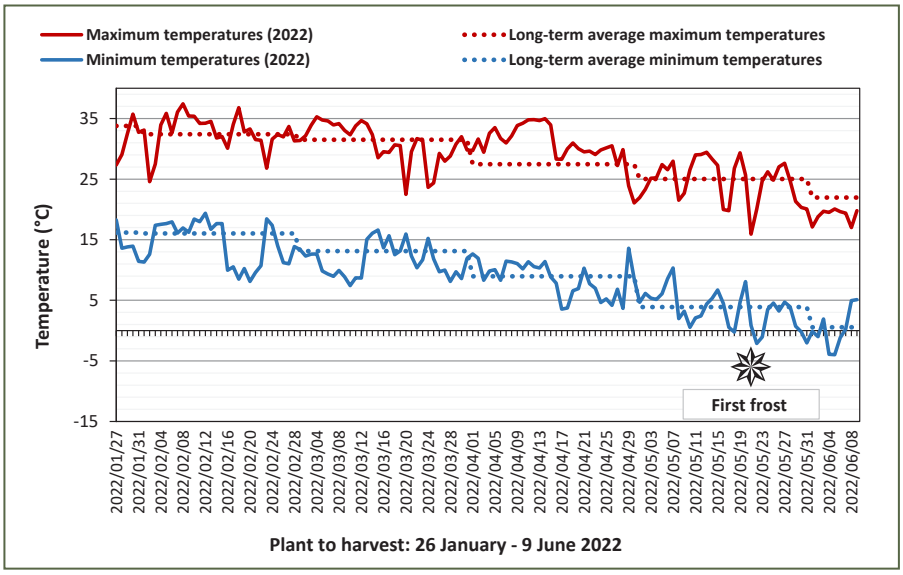


Figure 3: Minimum and maximum temperatures during the 2022 season as well as long-term temperatures.



In this particular trial, the marketing index was calculated based on the prices of only Class 1 potatoes.

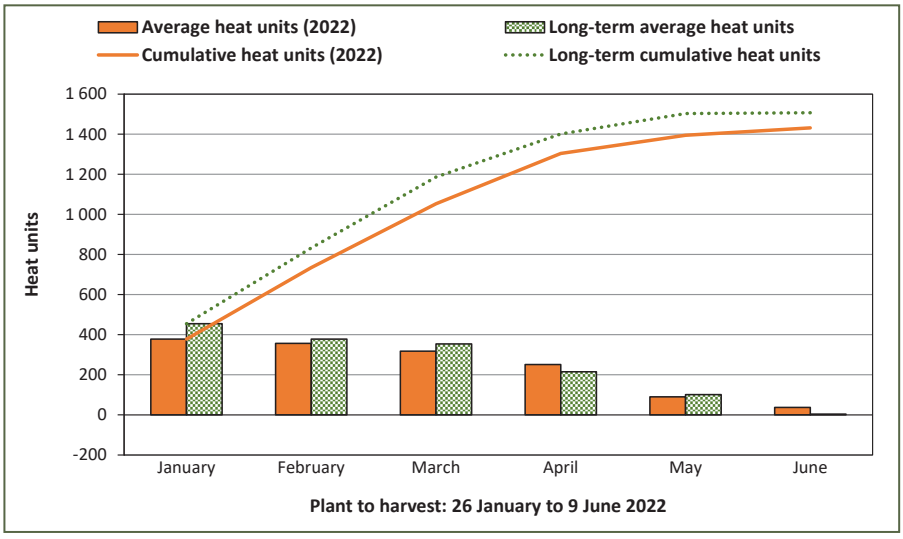
Corresponding price comparisons are then made with market prices as obtained at the time of harvest. The performance of new cultivars cannot be determined only on the basis of the results of one particular season, because climate varies from one year to the next. That is precisely why the cultivars are tested over a number of seasons.

As with any crop, temperature, availability of water (whether through irrigation scheduling or rainfall), as well as heat units are important factors that play a significant role during the potato plant's growth. These factors are therefore taken into account when a trial is evaluated.

Much lower rainfall

The season's rainfall was much lower than the normal long-term average

Figure 4: Heat units during the 2022 season as well as the long-term average heat units.



**Total heat units determined specifically for potatoes as a crop (threshold temperature = 5°C). Calculated from hourly data.*

rainfall for the entire growing season (*Figure 2*). Producers in this dry continental region rely heavily on good irrigation scheduling for potato production.

Minimum and maximum temperatures are detailed in *Figure 3*. Since the end of May, sub-zero temperatures were frequently recorded, resulting in natural leaf senescence.

The collection of heat units during a growth period is an important factor in the development of a plant. The heat unit trend available for the cultivar trial of this particular season at Douglas appears to be lower, but close to the long-term heat unit trend (*Figure 4*).

Yield data collected during harvest day is subjected to

Table 3: Characteristics regarding growth period, plant readiness, population density (%) and haulm counts for the relevant cultivars.

Cultivar	Growth period (days)[1]		Plant readiness[2]	Population density (%)	Haulms per plant	Haulms per ha
7 Four 7	Short	(80)	3	93	4.0	165 332
Belmonda	Medium	(100-110)	3	*	*	*
Connect	Long	(120)	3	73	4.7	152 487
Lanorma	Short	(80-90)	3	70	4.6	143 110
Mondial	Short to medium	(95-110)	3	100	4.0	177 776
Noha	Medium	(100)	2	100	4.6	204 442
Taisiya	Short to medium	(100)	3	87	4.2	162 398

[1]General guidelines and categories (days from emergence to natural leaf senescence, depending on the season): Short: 70 to 90 days; short to medium: 80 to 100 days; medium: 90 to 110 days; medium to long: 90 to 120; long: 90 to 140 days.
[2]Plant readiness of seed potatoes: 1 – fresh, 2 – slightly fresh, 3 – ready to plant, 4 – slightly old, 5 – old.
**Population density and haulm count are omitted.*

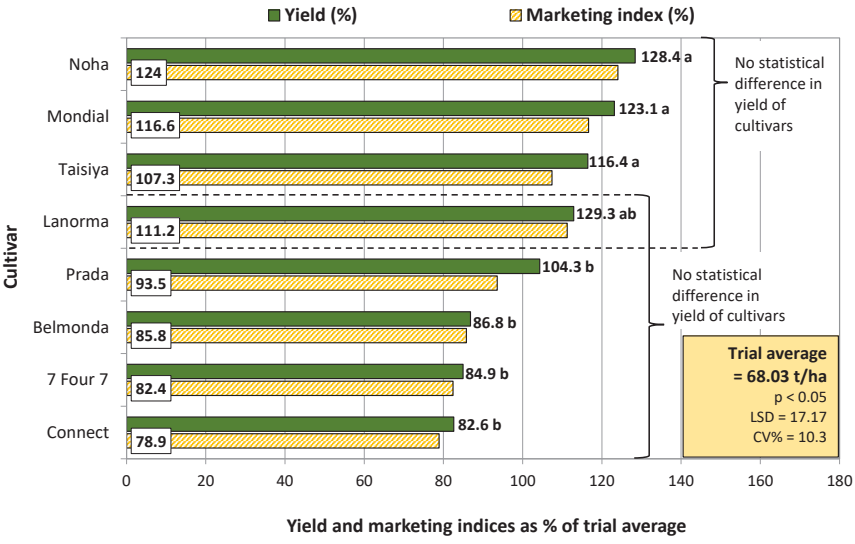
Table 4: Main reasons for downgrading during the 2022 Douglas trial.

Cultivar	Malformation	Growth cracks	Common scab	Mechanical damage	Moth	Greening	Hollow heart	Brown spot
7 Four 7	X	X						
Belmonda			X	X			X	
Connect	X	X			X			
Lanorma	X				X		X	
Mondial	X			X				
Noha					X			
Prada				X	X	X		
Taisiya	X							

statistical processing using the GenStat® program. The Tukey test of least significant differences (LSD) was used to separate the mean. The cultivar effect during this particular trial (*Figure 5*) was statistically significant ($p<0.05$) and the coefficient of variation (CV) was acceptable (10.3%) for processing. These factors indicate that the trial was well conducted, and the results are therefore reliable.

The yield of each cultivar is divided by the trial average (the trial average of all the cultivars is taken as 100%) and the yield performance of

Figure 5: Total yield and marketing indices per cultivar as a percentage of the trial average.



**Values followed by the same letter are not significantly different from one another.*

Figure 6: Grading of each cultivar.

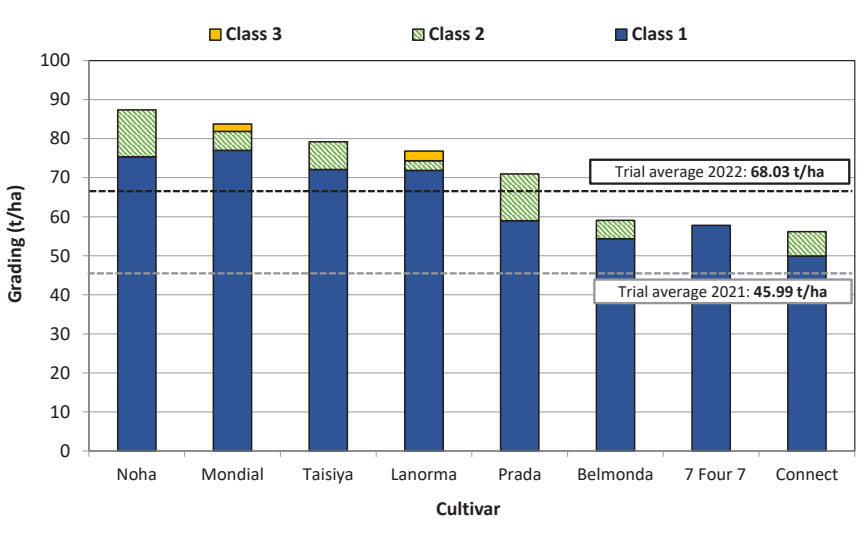


Table 5: Processing characteristics of cultivars. (Performed by ARC-Roodeplaat)

Cultivar	Chip colour[1]	SG[2]	Dry matter (%)[3]
7 Four 7	40	1.072	18.42
Belmonda	50	1.083	20.88
Connect	39	1.074	18.99
Lanorma	50	1.068	17.59
Mondial	48	1.060	15.95
Noha	38	1.070	18.01
Taisiya	52	1.068	17.62
<Norm (unacceptable for processing)		≥ Norm (acceptable for processing)	

[1]Chip colour with a value >50 and without defects is acceptable for the dry chip industry.
[2]Specific gravity of ≥1.075 is acceptable for the processing industry.
*[3]The percentage of dry matter is a calculated value: DM% = 24.182 + 211.04 * (SG-1.0988). The actual percentage value will vary slightly between varieties from this calculated value.*
**Data for Prada not available – sample went missing.*

Figure 7: Size group distribution of each cultivar.

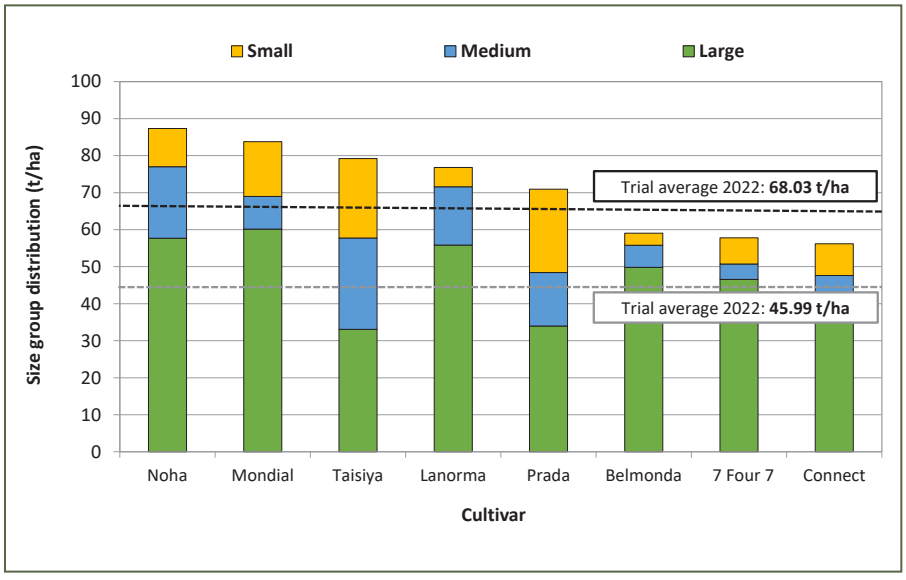
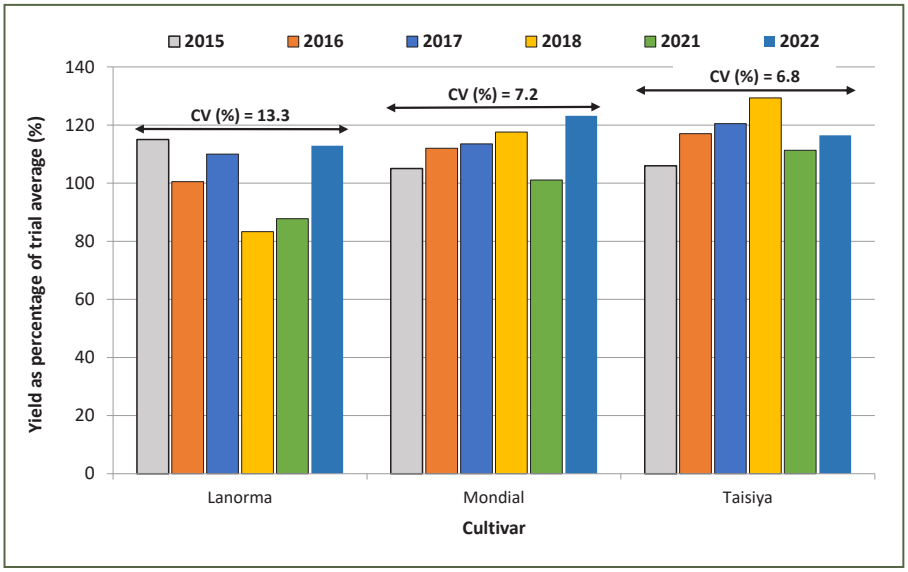


Figure 8: Performance of cultivars over four years, expressed as a percentage of the trial average.



each cultivar is then expressed as a percentage of the trial average (yield index).

The average yield of the trial for the 2022 season was 68.03 t/ha, whereas the trial average of the last trial conducted in 2021 was 45.99 t/ha. This can be attributed, among other things, to the fact that this trial was carried out almost three months earlier than normal.

Highest yields

The cultivars Noha, Mondial, Taisiya and Lanorma produced the highest yields based on statistically significant differences. Noha achieved the highest marketing index, which can be attributed to a good yield in Large and Medium tubers, as well as the absence of Class 3 tubers (*Figures 6* and *7*). The main reasons for the downgrading of each cultivar (*Table 4*) are examined to determine what challenges the cultivars in question experienced in terms of quality index. Moth damage and malformation were the main reasons for downgrading.

Cultivar performance tends to fluctuate between seasons, simply because climate differs from one season to the next. Hence, it is important to consider the consistent performance of cultivars over a number of seasons (*Figure 8*). Mondial and Taisiya currently exhibit the least variation from 2016 to 2021 for the Douglas trial.

Finally, to meet processing requirements, cultivars must meet a chip colour standard of >50 and a specific gravity (SG) of ≥1.075. Only Taisiya met the chip colour standard while Belmonda met the SG standard (*Table 5*).

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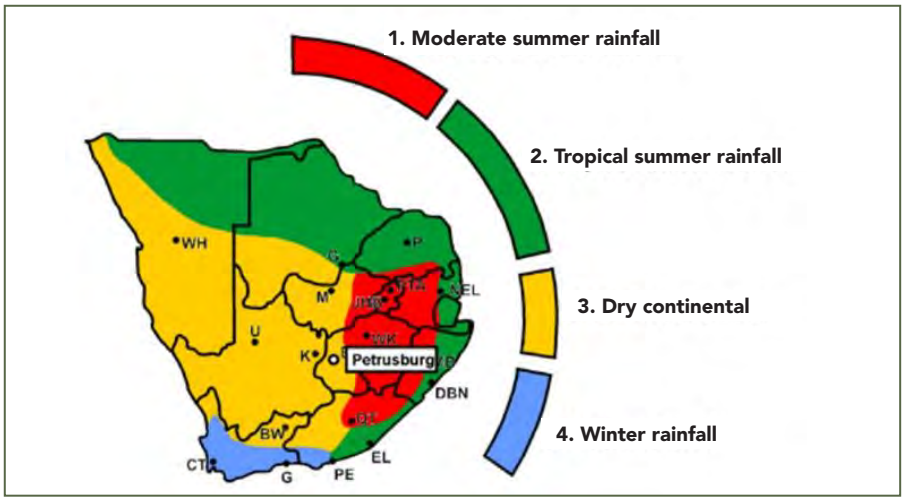
Southwestern Free State cultivar trial under irrigation at Petrusburg in 2022

By Enrike Verster and Anjé Erasmus, Potatoes SA and Johan Odendal, producer

Approximately 3% of South Africa's commercial potatoes are produced on 1 473 ha in the Southwestern Free State potato production region. The main cultivars produced for commercial consumption (table and processing) are the region's main harvest of Sifra (80%), Innovator (9%) and Mondial (5%).

Petrusburg is located in South Africa's dry continental area (*Figure 1*) and the farm on which the trial was planted, has received an annual average rainfall of 554 mm over the last 22 years. This region is characterised by very hot summers and cold winters, with frost occurring from June to August. The region even recorded frost in November 2017.

Figure 1: Location of Petrusburg in the Southwestern Free State production area.



The cultivar trial at Petrusburg was laid out in a randomised block design with three replications per cultivar. Relevant technical information relating to the trial is summarised in *Table 1*. Soil samples were taken before planting to determine the soil nutrient status of the trial site (*Table 2*).

Cultivars with short and long growing periods were included in the cultivar trial. As a result, growing periods could affect the yield of certain cultivars. The length of growing periods is subject to the nature of a given season, but is regarded as the time that passes from emergence to natural leaf senescence.

Table 3 provides an outline of how these growth periods vary from cultivar

Table 1: Summary of technical information regarding trial site and layout.

Farm	**Lushof Farm, Theronskop**		
Producer	Johan Odendal		
Planting date	25 August 2022		
Harvest date	20 January 2023		
Irrigation/dryland	Irrigation		
Double or single rows	Double rows		
Leaf senescence	Chemical		
Interrow spacing	0.75 m		
Intrarow spacing	28 cm		
Plant density	39 685 plants / hectare		
Fertiliser programme	**Nutritional value**		
	N (kg/ha)	P (kg/ha)	K (kg/ha)
Total	296	142	154

Figure 2: Rainfall during the 2022-2023 season as well as the long-term average rainfall.

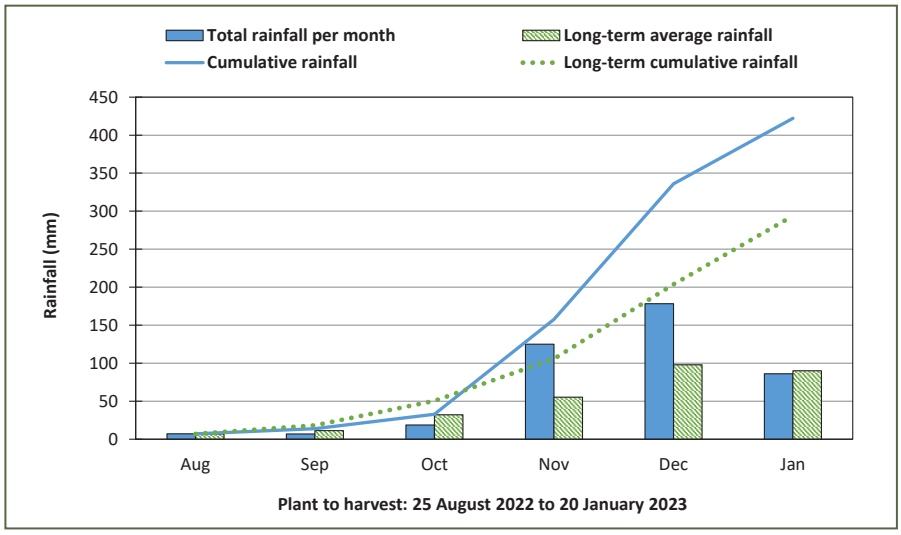
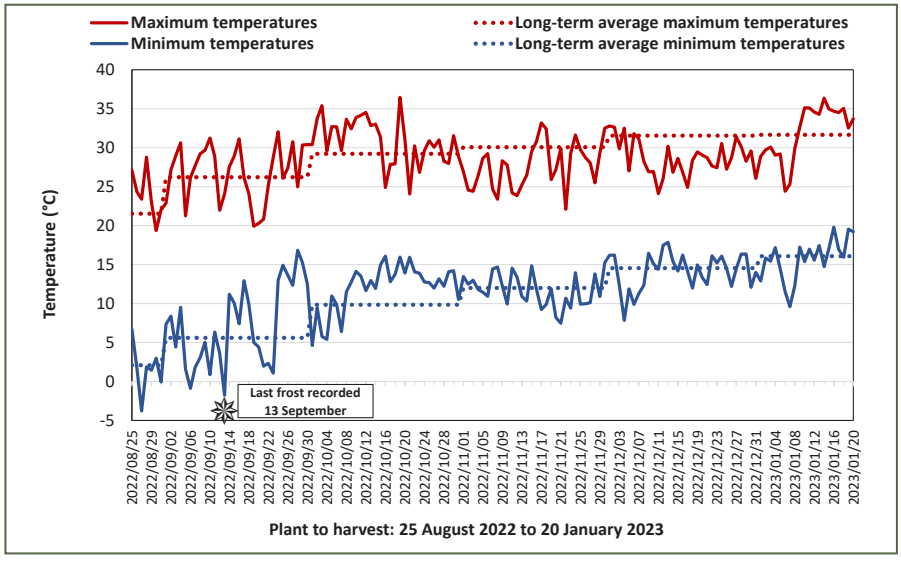


Figure 3: Minimum and maximum temperatures (°C) during the 2022/23 season as well as long-term average temperatures.



to cultivar. Plant readiness of the seed potatoes at the time of the trial, as well as plant density (%) and haulm count observed later on in the growing period, are indicated in *Table 3*.

Classing and sorting

The evaluation of new cultivars as in the case of the Petrusburg cultivar trial, delivered results regarding, among others, yield and marketing index. The marketing index of the relevant cultivars is calculated by classing and sorting each cultivar according to quality and size distribution, for example class 1 Large or class 2 Large-medium.

All three replications from this trial were thrown together, washed and sorted by the packing store. Price comparisons were then made to market prices at harvest time. The performance of new cultivars cannot be based on the results of one particular season only, since climate and seed potato quality can vary from one year to the next. It is for this very reason that cultivars are preferably tested across several seasons.

Temperature and water

As with any crop, temperature, availability of water (good irrigation schedules or rainfall), as well as heat units are important factors with a significant influence on the potato plant's growing period. These factors are therefore taken into consideration when evaluating cultivar performance. In the case of this trial, relevant daily data regarding the season in question was obtained from a Hortec weather station erected on the farm where the trial site is located.

However, long-term weather data was still obtained from an Agricultural Research Council (ARC) station as the Hortec weather station at the trial site has not been functioning long enough to generate long-term data. The ARC weather station from which the long-term data was obtained, is located 9 km from the trial site.

As the season progressed, the rainfall trend for the 2022/23 season (*Figure 2*) delivered significantly more cumulative rainfall than the long-term average rainfall. More

Table 2: Soil nutrient status of trial site before planting.

Gross density (kg.m^{-3})	pH (KCl)	P (P-Bray I)	K	Ca	Mg	Na	% of CEC[1] K	% of CEC[1] Ca	% of CEC[1] Mg	% of CEC[1] Na
		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	%	%	%	%
1 304	4.6	12	158	222	68	6	19	53	27	1

[1]*CEC = cation exchange capacity*

Table 3: Characteristics relating to growth period, plant readiness, population density (%) and haulm count for relevant cultivars.

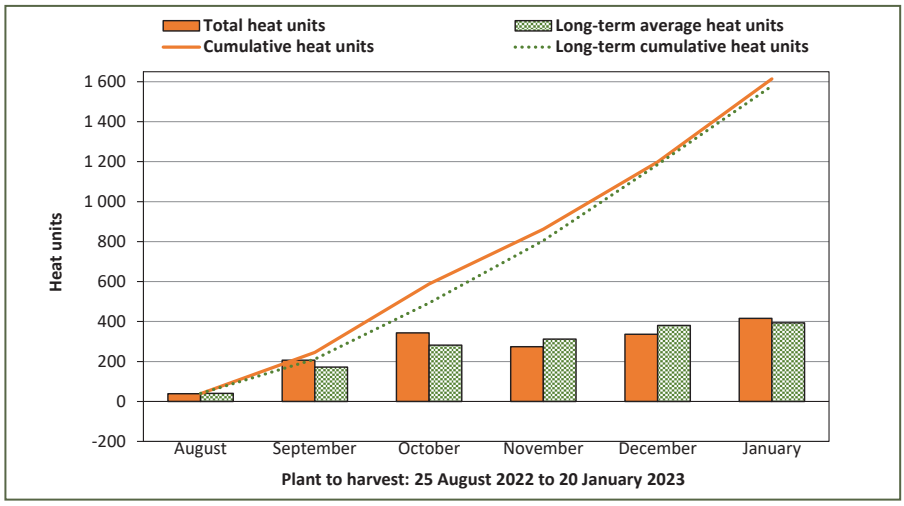
Cultivar	Growth period (days)[1]		Plant readiness[2]	Population density (%)[3]	Haulms per plant	Haulms per ha
11Z49A1	Medium	(100)	1	100	2.3	91 276
11Z55A5	Medium	(100)	1	100	2.1	83 339
Belmonda	Medium	(100-110)	1	100	3.4	134 929
Connect	Long	(120)	2	100	2.8	111 118
Foxy	Short to medium	(90-100)	2	86	4.5	95 562
Lanorma	Kort	(80-90)	1	100	2.8	111 118
Mondial	Medium to long	(110-115)	2	100	5.2	206 362
Noha	Medium	(100)	1	100	1.8	71 433
Noya	Short	(80-90)	2	100	2.3	91 276
Panamera	Medium	(90-110)	3	100	3.8	150 803
Sababa	Medium to long	(110-115)	2	100	3.6	142 866
Sifra	Short to medium	(90-100)	2	100	4.7	186 520
Sound	Medium	(110)	1	100	6.3	250 015
Tyson	Short to medium	(90-100)	3	100	2.6	103 181

[1]*General guidelines and categories (days from emergence to leaf senescence depending on the season):*
Short = 70-90 days; Short to medium = 80-100 days; Medium = 90-110 days; Medium to long = 90-120; Long = 90-140 days.
[2]*Plant readiness of seed potatoes: 1 = Fresh; 2 = Slightly fresh; 3 = Ready for planting; 4 = Slightly old; 5 = Old.*
[3]*Plant density (%) is determined by looking at the repetition of each cultivar which comprises of 36 plants per 10 m row per plot.*

Table 4: Main reasons for downgrading during the 2022 Petrusburg harvest.

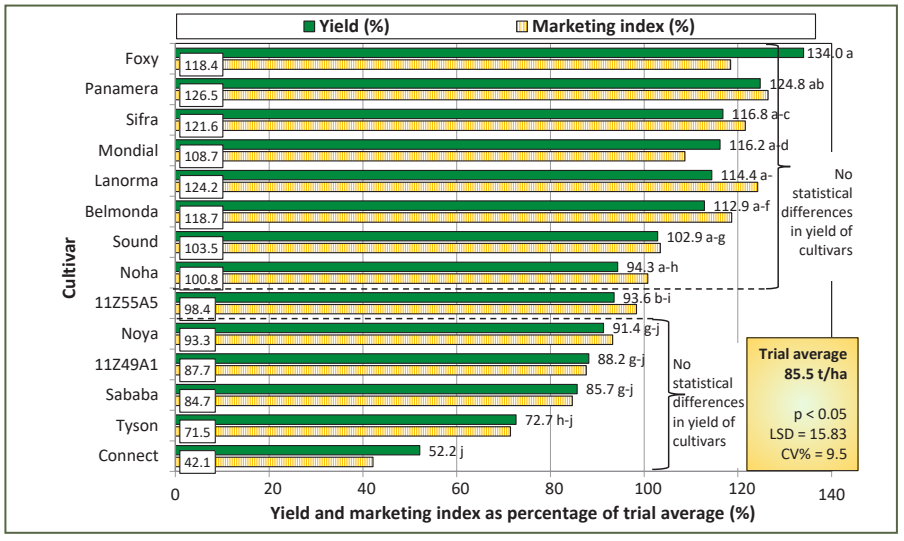
Cultivar	Loose skin	Sand split	Anthracnose	Moth damage	Malformation	Rot	Scab	Greening	Insect damage	Hollow heart	Brown spot
11Z49A1		x			x	x	x				
11Z55A5				x				x	x		
Belmonda											
Connect	x	x		x			x	x			
Foxy				x		x	x	x	x		
Lanorma	x			x	x					x	
Mondial		x		x	x			x			
Noha	x					x		x			
Noya	x			x		x		x			
Panamera				x				x			
Sababa					x	x		x	x		
Sifra	x			x		x					
Sound		x		x							
Tyson	x	x	x	x				x			x

Figure 4: Heat units (2022/2023 season) as well as long-term average heat units.



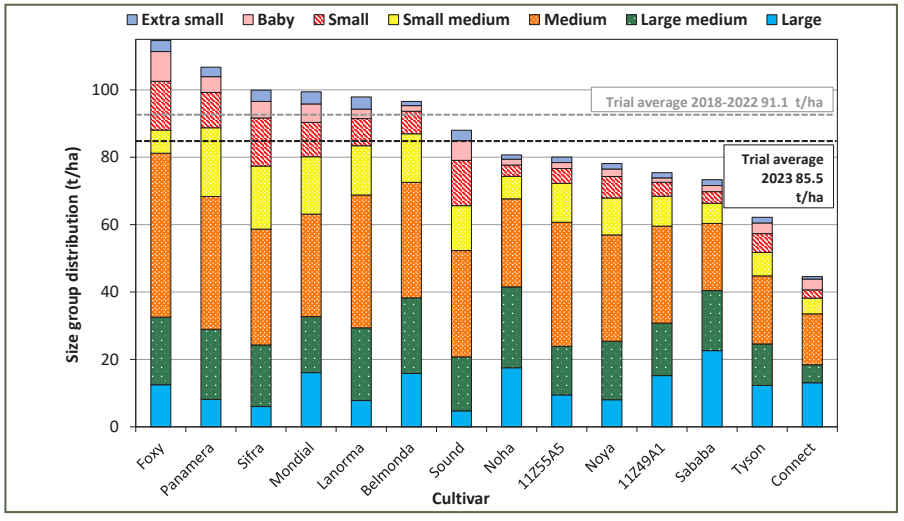
**Total heat units determined specifically for potatoes as a crop (temperature threshold = 5°C). Calculated using hourly data.*

Figure 5: Total yield and marketing index per cultivar as a percentage of the trial average.



**Values followed by the same letter do not differ significantly.*

Figure 6: Size distribution of all cultivars in the trial.



than double the long-term average rainfall was recorded in November, while extremely high rainfall was also recorded in December.

Influence of heat units

Figure 3 illustrates minimum and maximum temperatures. The last burst of frost was recorded on 13 September but there was no mention of significant frost damage to the younger plants. For the duration of the growing season, up to and including harvest day on 20 January, there were many days during which temperatures in excess of 30°C were recorded, but only a few days in October and January, nearing harvest day, recorded maximum temperatures higher than 35°C.

Heat units are another important factor to consider, as the development of the plant is mainly based on the collection of heat units during a growing period. The trend of available heat units for this cultivar trial, was lower throughout in respect of the cumulative long-term data of heat units (*Figure 4*). This can be attributed to the season's above-average rainfall which gave rise to numerous cloudy days followed by less accumulation of heat units.

The yield index

Yield data collected during harvest day, is statistically processed using the GenStat® program. The mean was separated using the Tukey test of least significant differences (LSD). The cultivar effect during this trial (*Figure 5*) was statistically significant ($p<0.05$) in terms of yield while the coefficient of variation (CV) was low (9.5%). These factors indicate that the trial was well executed, and the results are therefore reliable.

The yield of each cultivar is divided by the trial average (the average of all the cultivars is accepted as 100%). This creates a yield index and each cultivar's performance in terms of yield is read as a percentage of the trial average.

Trial yields

The average yield of the cultivar trial for the 2022/2023 season was 85.5 t/ha.

Figure 7: Grading of all cultivars in the trial.

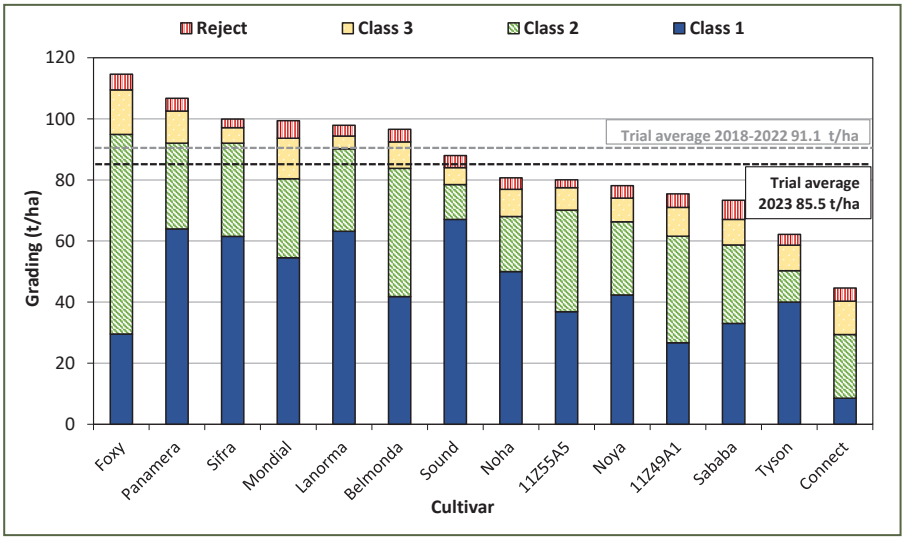
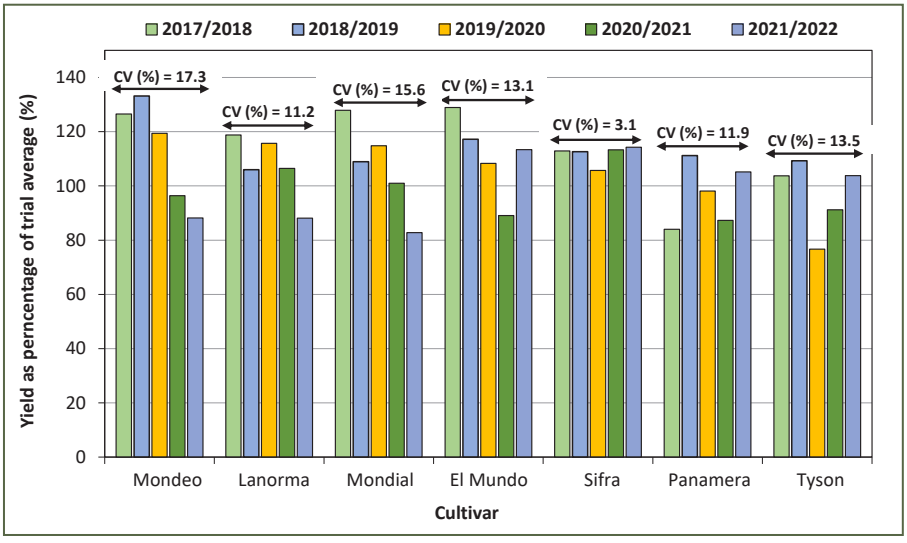


Figure 8: Performance of cultivars included in the trial for five years (indicated as % of trial average).



Coefficient of variation (CV%) is included on the graph: A value that essentially depicts the margin of difference in the specific cultivar's performance over the years indicated on the graph. The greater the CV % value, the greater the cultivar's performance variance over the number of years indicated on the graph.

This is much lower than the trial average of the previous three cultivar trials (100 t/ha) at Petrusburg (2019 to 2022). The three previous seasons delivered far more above-average yields than the previous years.

The past season's below-average performance can be attributed to various factors. The plants were subjected to stress due to excessive rainfall during tuber formation and filling. Several days of overcast weather led to reduced photosynthesis, and the wet and cloudy conditions created perfect conditions for blight. Many plants suffered as a result.

Statistically, the cultivars Foxy, Panamera, Sifra, Mondial, Lanorma, Belmonda, Sound and Noha all delivered the highest yield (*Figure 5*). Panamera and Lanorma achieved the highest marketing index, which can be attributed to the higher yield of large tubers as well as good quality cultivars.

Aspects relating to marketability

Size distribution and grading are indispensable evaluations when studying a cultivar's marketability (*Figures 6* and *7*). Reasons for downgrading are taken into consideration when the potatoes are classed (*Table 4*). The main reasons for downgrading were moths and greening, probably due to heavy rains that washed open the furrows. This led to a larger amount of class 2 and 3 potatoes. Brown spot and hollow heart were observed in a few cultivars.

Table 5: Processing characteristics of cultivars. (Carried out by ARC-Roodeplaat)

Cultivar	Chip colour[1]	SG[2]	Dry matter (DM %)[3]
11Z49A1	50	1.066	17.2
11Z55A5	59	1.063	16.6
Belmonda	53	1.077	25.5
Connect	51	1.072	18.6
Foxy	57	1.075	19.2
Lanorma	56	1.069	17.9
Mondial	55	1.071	18.3
Noha	55	1.072	18.6
Noya	49	1.075	19.2
Panamera	55	1.069	18.0
Sababa	54	1.065	17.0
Sifra	49	1.063	16.7
Sound	55	1.064	16.9
Tyson	58	1.065	17.1

[1]Chip colour with value >50 and without defects is acceptable for the dry chip industry.
[2]Specific gravity (SG) of ≥1.075 is acceptable to the processing industry.
*[3]The percentage of dry matter is a calculated value: DM% = 24.182 + 211.04 * (SG-1.0988). From this calculation value, the actual percentage value will differ slightly among cultivars.*

As seasons tend to fluctuate, so does the performance of cultivars change from one season to the next. This is simply because climate is never the same from one season to another. Therefore, it is important to consider consistent cultivar performance across seasons, instead of making decisions based on just one season's good performance. Sifra is currently exhibiting the least variation by far throughout 2017 to 2022 in the Petrusburg cultivar trial (*Figure 8*).

Finally, when observing the internal quality of potatoes, processing characteristics can be evaluated as well. To comply with processing requirements, cultivars have to comply with a chip colour norm of >50 and a specific gravity (SG) of ≥1.075 (*Table 5*). Several cultivars met the chip colour requirements and Belmonda, Foxy and Noya met the SG requirements.

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Western Free State cultivar trial under irrigation at Bultfontein in 2022

By Enrike Verster and Anjé Erasmus, Potatoes SA, and Izak Cronjé, producer

The Western Free State is a major potato producing with 30 producers producing potatoes on approximately 6 756 ha. The most prominent cultivars produced here (approximately 72% seed potatoes and 28% table potatoes, mostly under irrigation) are Sifra (34%), Panamera (31%) and Mondial (17%).

Bultfontein is located in South Africa's summer rainfall area (*Figure 1*) and received an average rainfall of approximately 525 mm rain over the past 18 years. The region's moderate climate includes very hot summers (at its warmest during December/January) to cold winters with frost occurring from April to August.

Cultivar conditions and layout

The Bultfontein cultivar trial was conducted in sandy loam soil and planted in a randomised block design with three replications per cultivar. *Table 1* contains technical information relevant to the trial.

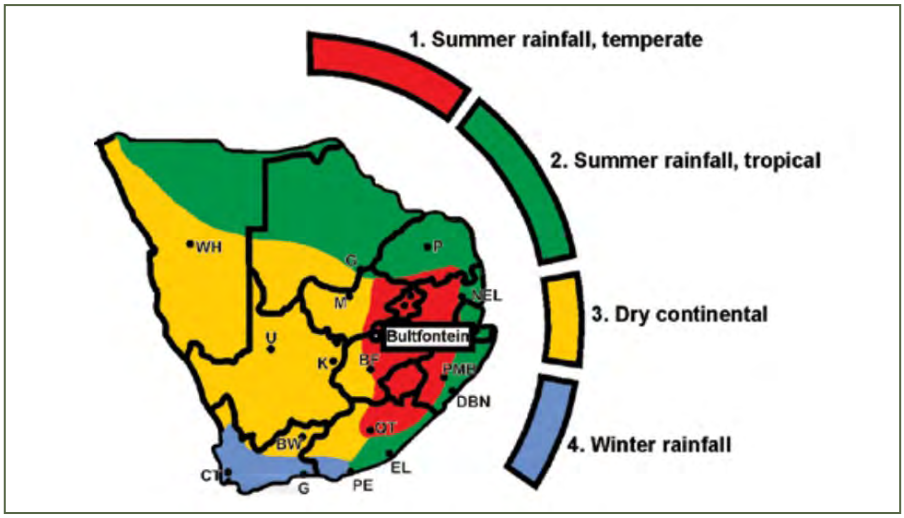
Included in the cultivar trial were cultivars with short to long growing periods. Growing periods can therefore influence the eventual yield of certain cultivars. Growing period length is subject to the nature of the season, but is regarded as the amount of time that passes from emergence to natural leaf senescence. *Table 2* sets out how growing periods differ from one cultivar to the next. Environmental factors and management practices also influence the various growing phases and their commencement.

Tuber size and yield are influenced by plant density and number of haulms per seed potato. The total number of eyes per tuber is determined by the cultivar and dictates how many sprouts are produced per tuber. In this regard, the plant readiness of seed potatoes is very important since plant-ready seed potatoes have been known to improve sprouting and, per cultivar, produce the ideal number of stems per sprout as tubers that are not yet plant-ready.

Seed potatoes that are too old form numerous stems and small tubers. *Table 2* indicates the plant readiness of seed potatoes at the time of the trial planting, along with

Cultivars with short to long growing periods are included in the trial and ultimately the growing periods had an influence on the yield of certain cultivars.

Figure 1: Location of Bultfontein in the Western Free State production area.



population density percentage and haulm counts recorded later during the growing period. Representative soil samples were collected before planting, and analysed to determine the soil nutrient status of the trial site (*Table 3*).

Classing and sorting

The evaluation of cultivars, like in the case of the Bultfontein cultivar trial, provides results regarding, among others, the yield and marketing indices. The marketing index of the cultivars concerned is calculated by classing each cultivar, and sorting it according to quality and size groups

Table 1: Summary of technical information regarding the trial site and design.

Farm	**Oasis**					
Producer	Izak Cronjé					
Planting date	18 January 2022					
Harvest date	15 September 2022					
Irrigation/dryland	Irrigation					
Double or single rows	Double row in one ridge					
Leaf senescence	Natural					
Spacing between rows	1.00 m					
In-row spacing	37 cm					
Trial site	20 m^2					
Plant density	27 000 plante/ha					
Fertiliser programme						
Nutritional value						
	N (kg/ha)	**P (kg/ha)**	**K (kg/ha)**	**Ca (kg/ha)**	**Mg (kg/ha)**	**S (kg/ha)**
Total	**296.1**	**103.9**	**186.9**	**114.1**	**43.0**	**86.6**

Figure 2: Rainfall (2022 season) and long-term average rainfall.

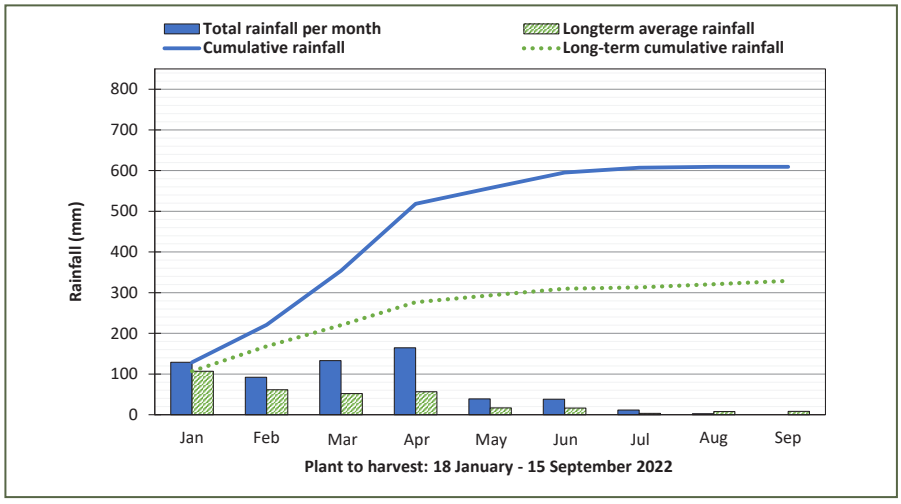
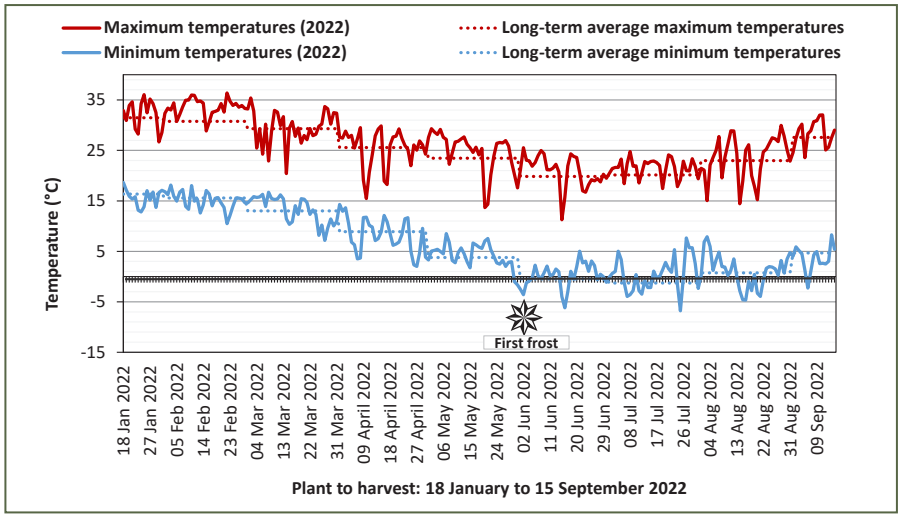


Figure 3: Minimum and maximum temperatures during the 2022 season as well as long-term temperatures



(for example, Class 1 Large or Class 2 Large to medium).

In this trial all three replications were thrown together, and classed and sorted by the packhouse. Price comparisons were then made in accordance with market prices obtained during harvesting. Cultivar performance cannot be analysed only on the basis of one season, as the climate will vary from one year to the next. For that reason, cultivars are tested across a number of seasons.

Environmental and weather conditions

As with any crop, aspects such as temperature, water availability (whether via good irrigation scheduling or rainfall), as well as heat units are important factors that play a significant role during the growing period of the potato plant. These factors are therefore taken into account when evaluating the performance of cultivars. Relevant daily and long-term weather data was obtained from the nearest ARC weather station.

Before the season commenced, the rain received in December (the month prior to planting) gave rise to a well-saturated soil profile. Rainfall of slightly more than 200 mm was recorded for December and is compared to the long-term average rainfall in *Figure 2*. The remainder of the active growing period was characterised by consistently above-average rainfall with regular showers that led to generally wet conditions.

Quality problems and subsequent lower yields can probably be attributed to the far-above average rainfall (also in the winter months after senescence) experienced especially during March and April (tuber fill and adult stages). Another major reason for the lower yield was the above average prevalence of late blight since mid-March, a period which represents the active growing period.

Minimum and maximum temperatures are reflected in *Figure 3*. Major fluctuations were continuously recorded, especially in maximum temperatures. Towards the

Table 2: Traits relating to growth period, plant readiness, population density (%) and haulm count for relevant cultivars.

Cultivar	Growing period (days)[1]		Plant-readiness[2]	Population density (%)[3]	Haulms per plant	Haulms per ha
Adato	Medium to long	(120)	3	80	3.8	82 080
Allison	Medium to long	(120)	3	89	3.8	91 314
Belmonda	Medium	(100-110)	3	80	3.4	73 440
Connect	Long	(120)	3	80	5.0	108 000
Foxy	Short to medium	(90-100)	3	83	3.8	85 158
Lanorma	Short	(80-90)	3	83	2.8	62 748
Mondial	Medium to long	(110-115)	3	78	4.6	96 876
Panamera	Medium	(90-110)	3	83	4.0	89 640
Sababa	Medium to long	(110-115)	3	75	5.8	117 450
Sifra	Short to medium	(90-100)	3	78	6.2	103 572
Sound	Medium	(110)	3	78	4.2	88 452
Tyson	Short to medium	(90-100)	3	78	3.4	71 604

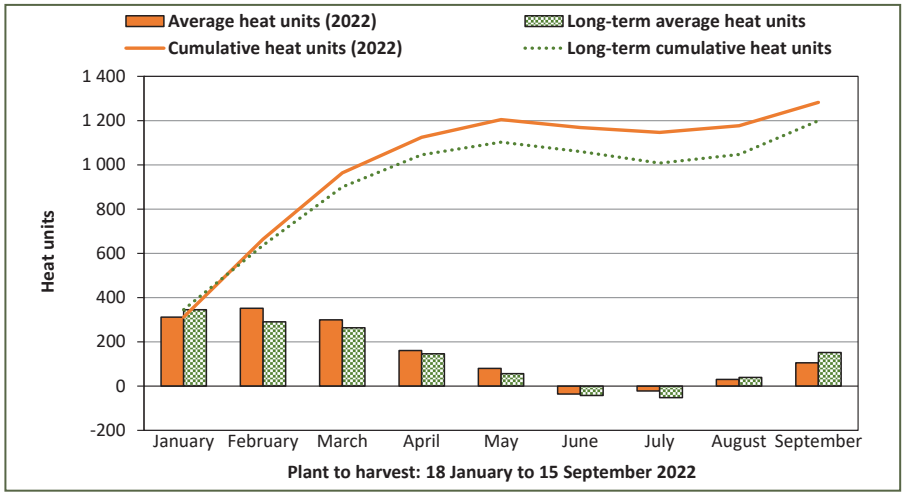
[1]General guidelines and categories (days from emergence to leaf senescence, depending on the season): Short = 70 to 90 days; Short to medium = 80 to 100 days; Medium = 90 to 110 days; Medium to long = 90 to 120; Long = 90 to 140 days.
[2]Plant readiness of seed potatoes: 1 = Fresh, 2 = Slightly fresh, 3 = Plant ready, 4 = Slightly old, 5 = Old.
[3]The population density percentage is determined by looking at the repetition of each cultivar comprising 18 plants/row/per 10 m, thus equating to 36 plants per plot (double row).

Table 3: Soil nutrient status of trial site before planting.

pH (KCl)	P (P-Bray I)	K	Ca	Mg	Na
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
7.0	20	200	400	120	60

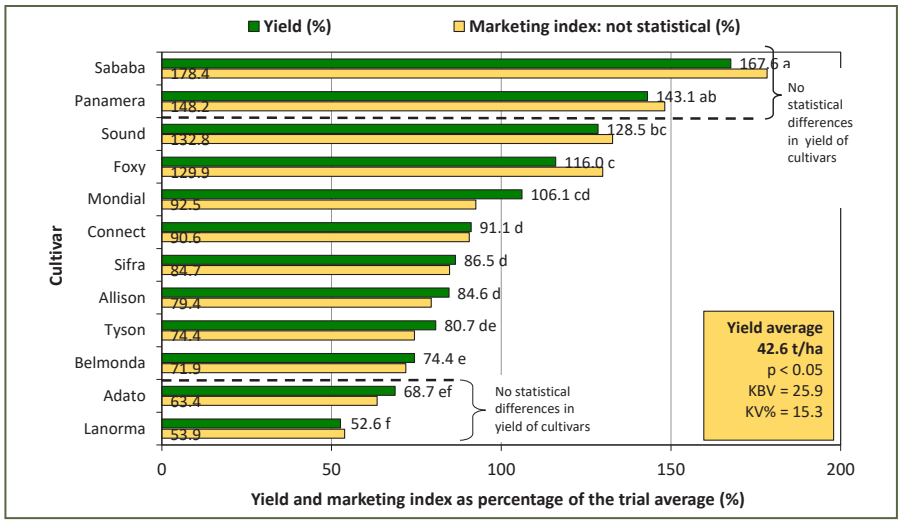
The Bultfontein cultivar trial was conducted in sandy loam soil and planted in a randomised block design with three replications per cultivar.

Figure 4: Heat units during the 2021 season as well as long-term average heat units.



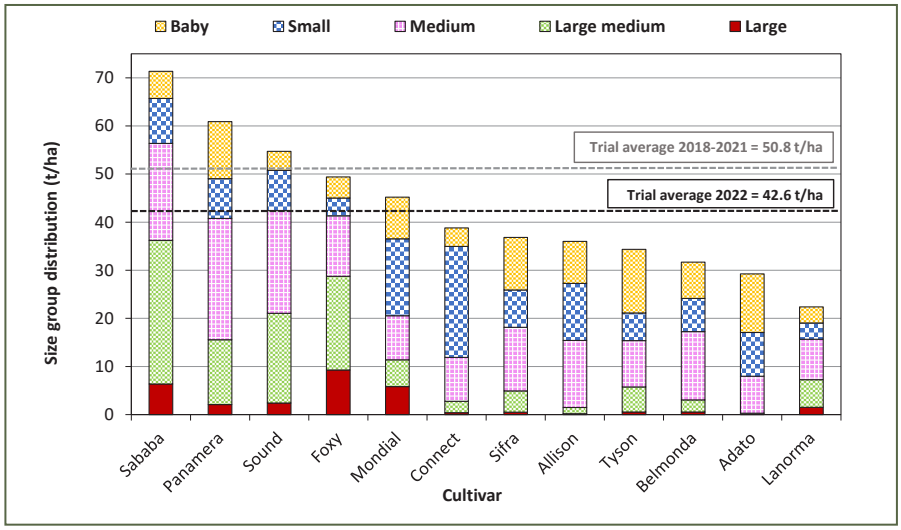
**Total heat units determined specifically for potatoes as a crop (threshold temperature = 5°C). Calculated from hourly data.*

Figure 5: Total yield and marketing index per cultivar as a percentage of the trial average.



**Values followed by the same letter are not significantly different from one another.*

Figure 6: Size distribution of each cultivar.



Tuber size and yield are influenced by stand and number of haulms per seed potato.

end of May 2022 temperatures below freezing point were recorded and, along with it, natural leaf senescence.

Role of heat units

The accumulation of heat units during a growing period is an important factor in the development of a plant. The trend of heat units available for the cultivar trial of the season in question appeared to be much higher than the long-term trend of the season as a whole (*Figure 4*).

Execution of the trial

Yield data collected during harvest day were subjected to statistical processing using the GenStat® program. The Tukey test of least significant differences (LSD) was used to separate the average. The cultivar effect during the trial (*Figure 5*) was statistically significant ($p<0.05$) and the coefficient of variation (CV) was low (15.3%).

These factors indicate that the trial was performed well, and the results are therefore reliable. The

Table 4: Main reasons for downgrading.

Cultivar	Growth cracks	Silver scurf / black spots	Anthracnose	Moth damage	Soft rot	Stem-end rot	Greening	Malformation	Insects
Adato		x		x			x		
Allison				x	x				
Belmonda		x		x					x
Connect			x	x		x			
Foxy		x		x			x		x
Lanorma		x							x
Mondial	x	x		x	x		x		
Panamera				x			x		
Sababa				x			x	x	x
Sifra		x		x					x
Sound	x			x	x		x		
Tyson				x			x	x	x

Table 5: Cooking and processing characteristics of cultivars (conducted by ARC-Roodeplaat).

Cultivar	Chip colour[1]	DM[2]	SG[3]
Adato	63	17.68	1.068
Allison	50	17.70	1.068
Belmonda	53	17.15	1.066
Connect	46	17.28	1.066
Foxy	50	16.23	1.061
Lanorma	59	15.93	1.060
Mondial	54	16.12	1.061
Panamera	53	18.21	1.071
Sababa	48	15.78	1.059
Sifra	57	15.23	1.056
Sound	50	16.54	1.063
Tyson	58	16.08	1.060

[1] Chip colour with a value of >50 and without defects is acceptable to the dry chip industry.
*[2]The percentage dry matter is a calculated value: DM% = 24.182 + 211.04 * (SG-1.0988). The actual percentage value will differ slightly among varieties.*
[3]Specific gravity of ≥1.075 is acceptable for the processing industry.

yield of each cultivar is divided by the trial average (the trial average of all the cultivars is taken as 100%). This creates a yield index and regards each cultivar's performance in terms of yield, as a percentage of the trial average.

Trial yield

The average yield of the trial for the 2022 season was 42.6 t/ha lower than the average yield of 50.8 t/ha over the past five seasons. The cultivars Sababa and Panamera delivered the highest yield. As mentioned earlier,

The trial's average yield for the 2022 season was 42.6 t/ha; this is lower than the average yield of 50.8 t/ha over the past five seasons.

the below-average yield of the trial for this particular season can possibly be ascribed to the consistently wet conditions as well as late blight. These factors gave rise to substantially fewer Large potatoes and more Small and Extra-small potatoes than during the previous season.

Sababa, Panamera, Sound and Foxy achieved the highest marketing index which can be ascribed to the very good yield of Large and Class 1 tubers (*Figures 5, 6* and *7*). Size group distribution and grading are indispensable evaluations when considering the marketability of a cultivar.

The main reasons for downgrading of each cultivar (*Table 4*) as well as internal quality are all important factors and must therefore also be evaluated. Moth damage and relatively low specific gravity (SG), as recorded in this experiment, are problems that can occur when tubers are left below-soil for such a long period prior to harvesting.

According to the available weather data, more heat units were recorded

Figure 7: Grading of each cultivar.

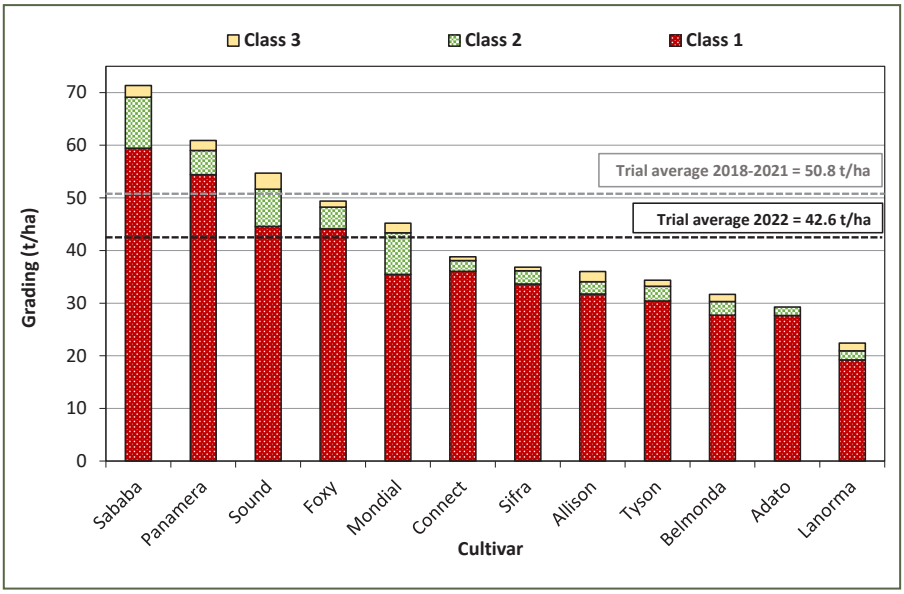
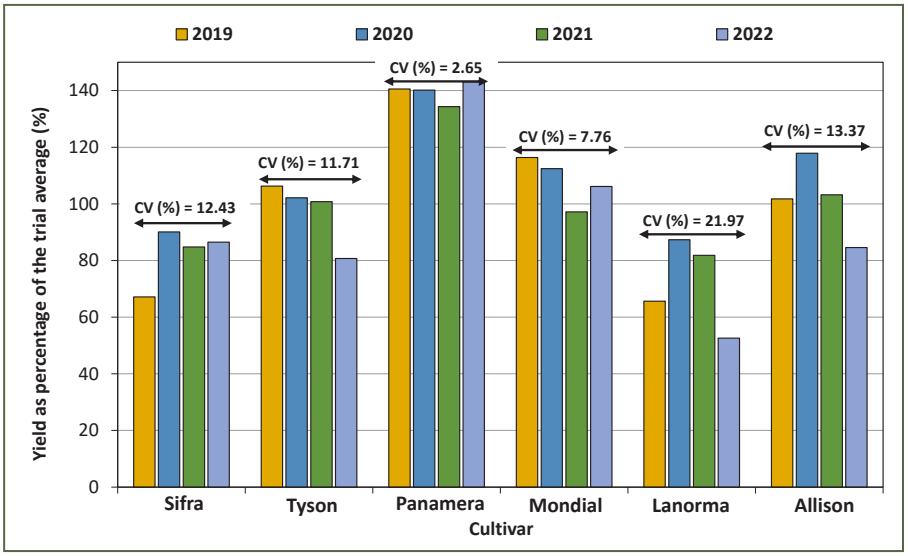


Figure 8: Performance of cultivars included in the trial for three years, expressed as a percentage of the trial average.



during the winter months than the long-term average, which may have contributed to higher moth pressure on potatoes found beneath the soil.

As can be expected, cultivar performance will fluctuate from one season to the next. This is simply because the climate is never the same. Hence, it is important to consider the consistent performance of cultivars across a number of seasons. Panamera and Mondial are currently exhibiting the least variation for the Bultfontein area from 2019 to 2022 (*Figure 8*).

Finally, cooking and processing properties can also be evaluated when studying the internal quality of potatoes. In order to meet processing requirements, cultivars must comply with a chip colour standard of >50 and an SG of ≥1.075. While many cultivars met the prescribed chip colour, none met the prescribed SG (*Table 5*).

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of the plant is largely based on the collection of heat units. It is therefore assumed that the plant must collect a certain number of heat units to complete a developmental phase.

The heat units for the 2022 growing season were slightly lower than the long-term average heat units and are indicated in *Figure 4*. At the end of the season, the cumulative heat units of the long-term data were 30.4% lower than the cumulative heat units of this year's season.

Cultivar performance and yield

Yield data collected during harvest was subject to statistical processing using the GenStat® program and the mean was separated using the Tukey test of least significant differences (LSD). The cultivar effect of the 2022 trial (*Figure 5*) was statistically significant ($p<0.05$) in terms of yield, while the coefficient of variation (CV) was low (16%). This indicates that the trials were well executed and that the results are reliable.

The average yield (77.7 t/ha) for the 2022 season was (27.3 t/ha) lower than the trial average of the previous three years (50.4 t/ha). During the 2022 trials (*Figure 5*) the cultivars Foxy, Sound, Valor, Panamera, Mondeo, Sifra and Sababa produced the highest yields and also delivered a higher yield than the trial average (77.7 t/ha).

In order to determine cultivar performance in terms of yield and quality, aspects such as yield,

Figure 3: Minimum and maximum temperatures (°C) during the 2022 growing season as well as the long-term temperature.

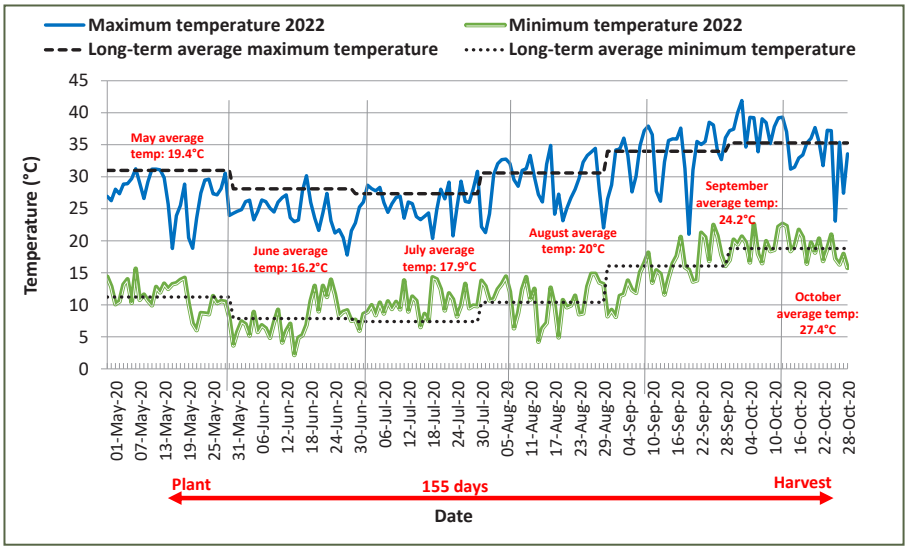
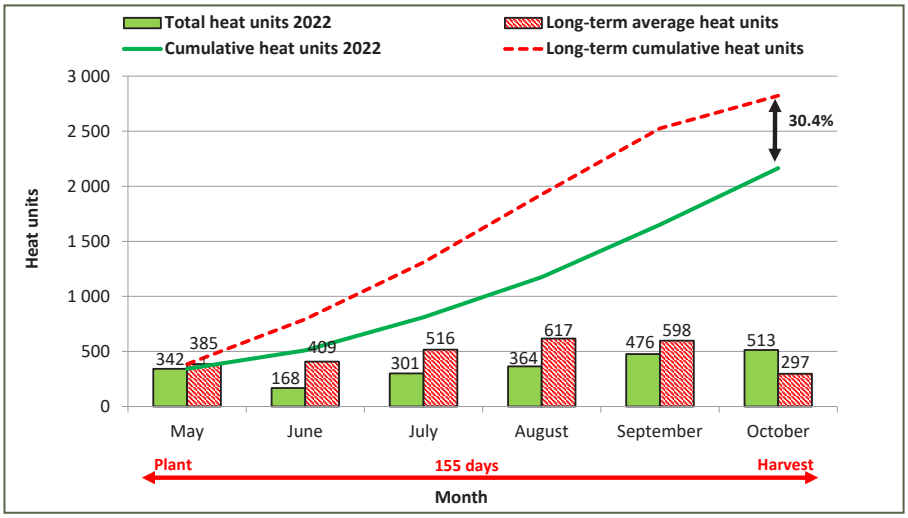


Figure 4: Heat units during the 2022 growing season, as well as the long-term average.



**Total heat units determined for potatoes (threshold temperature = 5°C) as a crop. Calculated from hourly data.*

Table 3: Characteristics relating to growth period, plant readiness, population density (%) and haulm count for each cultivar in the 2022 Tom Burke cultivar trial.

Agent	Cultivar	Growth period (days)[1]		Plant readiness[2]	Population density(%)	Haulms per plant	Haulms per ha
GWK	Connect	Medium to long	(120)	1	100	2.9	128 888
RegenZ	El Mundo	Short to medium	(90-100)	1	100	3.2	142 221
RSA	Foxy	Short to medium	(95-100)	4	100	4.7	208 887
GWK	Lanorma	Short	(80-90)	2	100	4.2	186 665
RegenZ	Mondeo	Medium	(90-110)	1	100	3	133 332
WEgrow	Mondial	Medium to long	(110-115)	4	93.9	3.8	158 585
WEgrow	Panamera	Long	(120-125)	3	100	3.8	168 887
WEgrow	Sababa	Medium to long	(110-115)	3	100	2.6	115 554
WEgrow	Sifra	Short to medium	(90-100)	1	96.9	2	86 132
First Potato Dynamics	Sound	Medium	(100)	4	90.9	4.8	193 918
GWK	Tyson	Short to medium	(90-100)	2	96.9	2	86 132
RSA	Valor	Medium	(100-110)	2	100	3.4	151 110
RegenZ	Vicenta	-	-	1	100	1.4	62 222

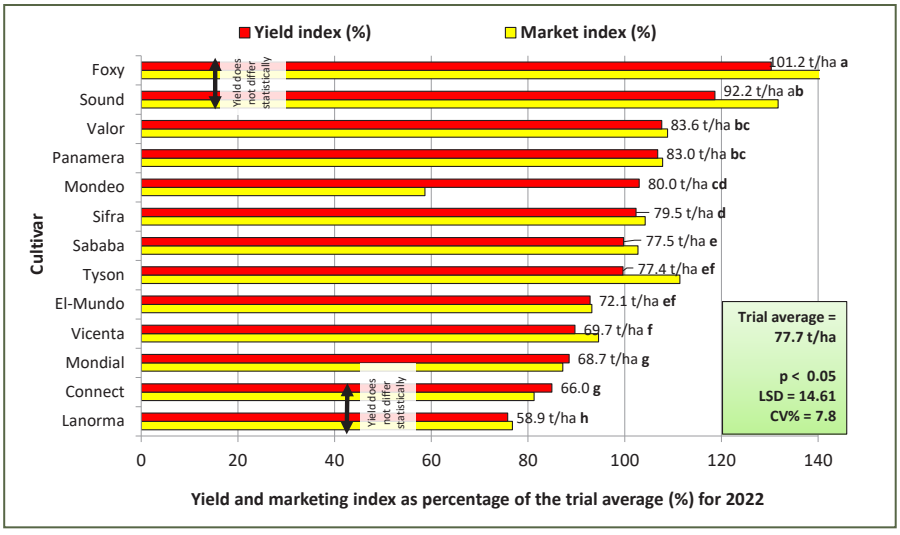
[1]*General guidelines and categories (days from emergence to natural leaf senescence, depending on the season): Short: 70-90 days; Short to medium = 80-100 days; Medium = 90-110 days; Medium to long = 90-120; Long = 90-140 days.*
[2]*Plant readiness of seed potatoes: 1 - Fresh; 2 - Slightly fresh; 3 - Ready for planting; 4 - Slightly old; 5 - Old.*

Table 4: Main reasons for downgrading during the 2022 Tom Burke harvest.

Cultivar	Growth cracks	Regrowth	Insect damage	Mechanical damage	Malformation	Moths	Abraded	Rhizoctonia	Common scab	Sand splitting	Silver scab and black dot	Stem-end rot	Greening	Rot
Connect		●				●	●		●		●			
El Mundo			●			●		●						
Foxy						●				●			●	
Lanorma								●			●			
Mondeo			●			●	●				●			
Mondial					●	●		●		●			●	●
Panamera	●						●				●			
Sababa														●
Sifra						●				●	●	●	●	
Sound						●		●		●	●			
Tyson		●		●										
Valor						●					●	●		
Vicenta						●				●	●			

● *<5% incidence* ● *5 tot 15% incidence* ● *>15% incidence*

Figure 5: Total yield and marketing index per cultivar as a percentage of the trial average.



**Values followed by the same letter do not differ significantly from one another.*

Figure 6: Size-group distribution of each cultivar during final harvest.

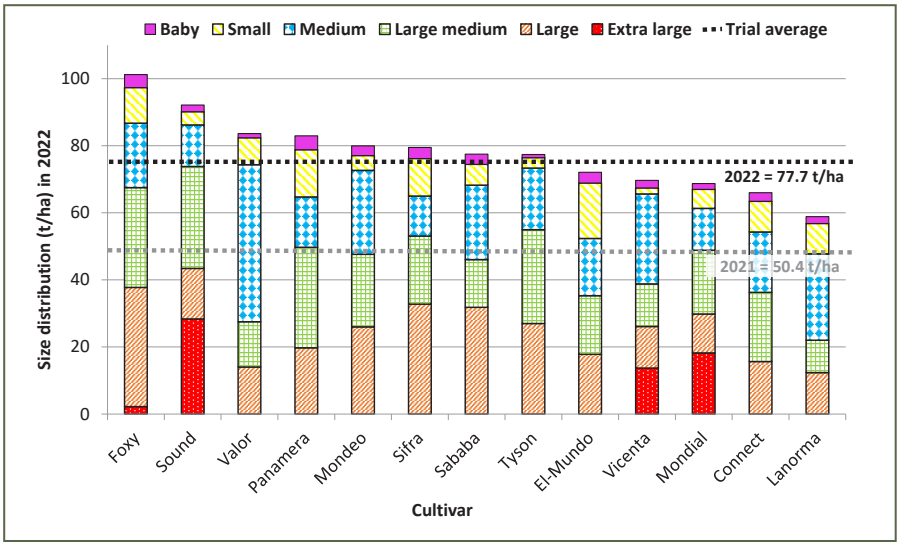
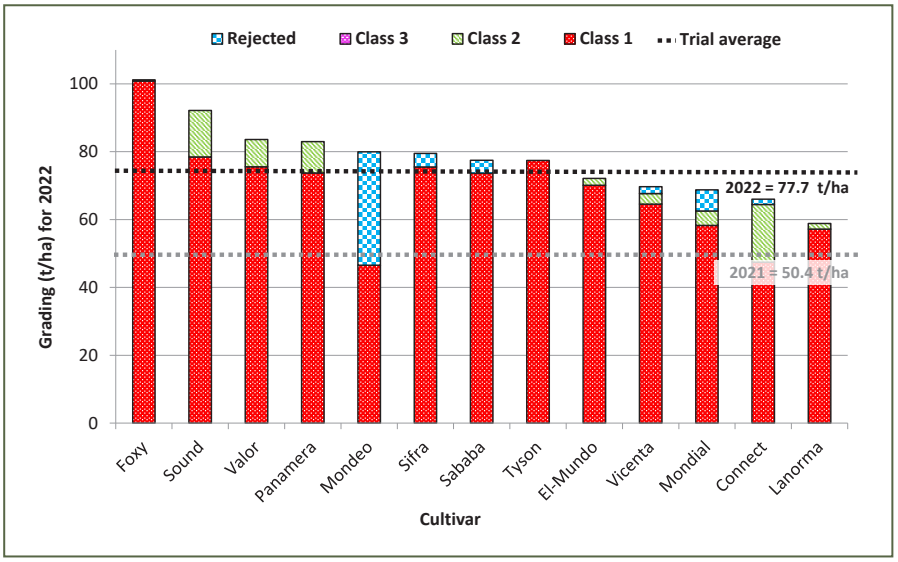


Figure 7: Grading of each cultivar during final harvest.



size-group distribution and class were considered to calculate a marketing index according to the average market prices for the day in question. The yield, multiplied by the prevailing price determined by the tuber size distribution and grading, provides the marketing index (*Figure 5*).

The highest marketing index, which was attained by Foxy and Sound, was the result of a high percentage of Large tuber size distribution (*Figure 6*) and a high percentage of Class 1 grading (*Figure 7*). Tuber size distribution and grading are also used to class potatoes. These factors are therefore crucial in ensuring an optimal, economically marketable yield.

Tuber size distribution is indicated in *Figure 6*, the grading of the yield in *Figure 7*, and the main reasons for the downgrading of the various cultivars are indicated in *Table 4*. High temperatures prior to harvest resulted in many downgrades because of regrowth.

Calculating yield potential

The LINTUL-POTATO-DSS plant growth model was used to calculate the potential potato yield of the control cultivar, Mondial (G4). Potential yield can be defined as the theoretical top yield limit in a situation in which water, nutrients and biological factors are optimal for the season during which the trial was grown. This information makes it possible to compare the actual yield obtained in the trial to simulated potential yields. The difference between the potential and actual yield is the yield gap. It illustrates how efficiently producers use their environment and available resources to achieve high yields.

The ratio between the actual (77.7 t/ha) and potential (85 t/ha) yield for this trial is 97%, revealing a small yield gap which indicates that the available environment was utilised efficiently. This means there are limited opportunities for further yield increases.

It is very important to note the consistency of cultivar performance

Table 5: Processing characteristics and internal quality for 2022. (Conducted by ARC-Roodeplaat).

Cultivar	Chip colour[1]	SG[2]	Dry matter (%)[3]	Hollow heart	Brown spot
Connect	50	1.071	18.38	0	0
El Mundo	48	1.065	17.05	0	0
Foxy	40	1.060	15.92	0	0
Lanorma	57	1.076	19.38	0	0
Mondeo	52	1.064	16.78	0	0
Mondial	57	1.071	18.24	0	0
Panamera	56	1.071	18.38	0	0
Sababa	60	1.066	17.27	0	0
Sifra	55	1.064	16.80	0	0
Sound	59	1.071	18.31	0	0
Tyson	56	1.067	17.44	0	0
Valor	52	1.074	18.96	0	0
Vicenta	54	1.076	19.26	0	0
≥ Norm (acceptable for processing)			<Norm (unacceptable for processing)		

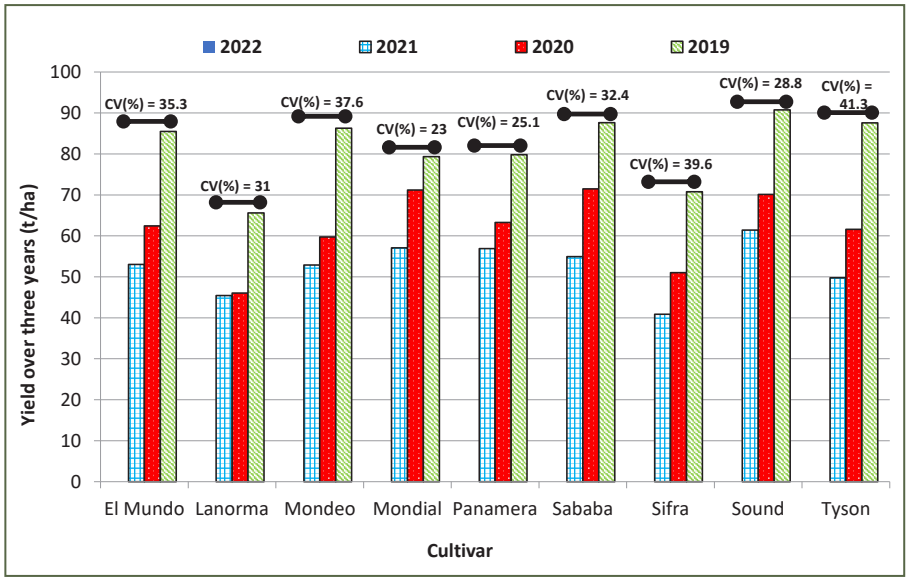
[1]Chip colour with a value of >50 and without defects is acceptable for the chip industry.
[2]Specific gravity of >1.075 is acceptable for the processing industry.
*[3]The percentage dry matter is a calculated value: DM% = 24.182 + 211.04 * (SG-1.0988). The actual percentage value will differ slightly between varieties based on this calculating value.*

despite climate fluctuations over time. *Figure 8* illustrates the three-year data for the cultivar trials in the Tom Burke production area. The coefficient of variation of every cultivar over three years is indicated above each cultivar. It would seem that Lanorma and Sound are showing the least variation for the Tom Burke area.

Furthermore, it is also important to focus on the internal quality of the product to ensure economical, optimally marketable returns and, hence, profitability. This includes important factors such as processing properties, specific gravity (SG) and internal defects (hollow heart and brown spot) which are summarised in *Tables 5* and *6*.

During the 2022 growing season, all the cultivars except El Mundo and Foxy met the norm of >50 for processing. Regarding SG, only Lanorma and Vicenta adhered to the norm of ≥1.075 for processing. No cultivar showed internal defects.

Figure 8: Performance of cultivars measured over three years, indicated as a percentage of the trial average.



Thank you to our contributors: Jako Nel, producer from Ratho Boerdery, Schalk Grobbelaar, chairperson of the working group, Renier Fourie of GWK, Chris Prinsloo of Wesgrow, Jeanine van Jaarsveld of FPD, and Michelle Lombard of RSA Potato Seed Exchange. For more information and enquiries, contact Dirk Uys at dirk@potatoes.co.za.

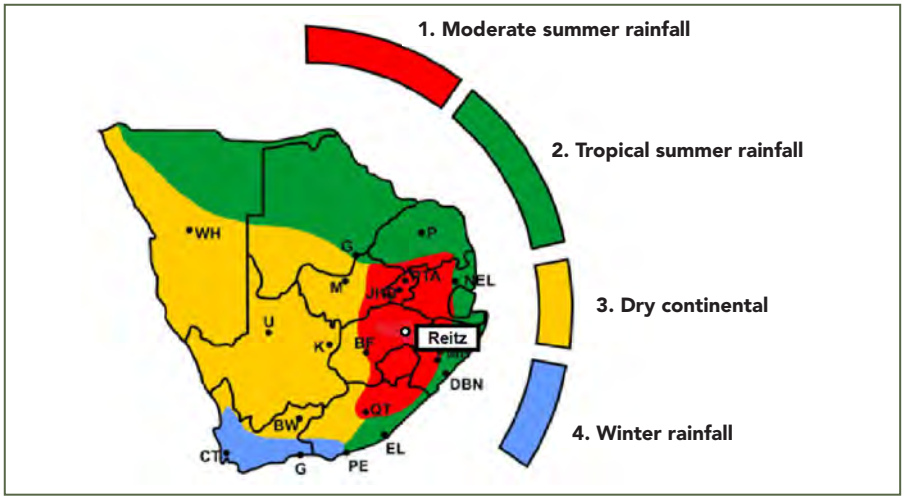
Eastern Free State dryland cultivar trial at Reitz in 2022/2023

By Enrike Verster and Anjé Erasmus, Potatoes SA, and Geyer Terblanche, Fick & Seun Boerdery

The Eastern Free State is a large potato production area where 48 of the country's producers are producing a substantial portion of the country's commercial potatoes on approximately 9 384 ha. The most prominent cultivars produced for table usage in this area are Mondial, Lanorma and Panamera.

Reitz is located in South Africa's temperate rainfall area (*Figure 1*) and has been receiving an average rainfall of 509 mm (local ARC weather station) over the past 19 years. The region is characterised by warm summers and very cold winters, with frost occurring from mid-May to early September.

Figure 1: Location of Reitz in the Eastern Free State production area.



The Reitz cultivar trial was laid out in a randomised block design with three replications per cultivar. *Table 1* contains additional technical information relating to the trial. Soil samples were taken prior to planting to determine the soil nutrient status of the trial site (*Table 2*).

Differences in growing periods

The cultivar trial included cultivars with short and long growing periods. Hence, growing periods can influence the eventual yield of certain cultivars. The length of growing periods is subject to the nature of the season, but is regarded as the amount of time that lapses from emergence to natural leaf senescence.

Table 1: Summary of technical information regarding trial site and layout.

Farm	**Middelbult (Fick & Seun Bdy)**			
Co-worker	Geyer Terblanche			
Planting date	21 October 2022			
Harvest date	16 March 2023			
Irrigation/dryland	Dryland			
Double or single rows	Staggered – double rows in contour			
Leaf senescence	Natural			
Interrow spacing	0.9 m			
In-row spacing	45 cm			
Trial site	18 m^2			
Fertilisation programme	**Nutritional value**			
	N (kg/ha)	P (kg/ha)	K (kg/ha)	Ca (kg/ha)
Total	120.35	69.01	113.8	31.0

Table 2: Soil nutrient status of the trial site before planting.

pH (H_2O)	P	Ca	Mg	K	B	Fe	Cu	B	Mn
	Mehlich III (ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
5.6	61	265	62	178	0.42	148	2.0	0.42	46

Table 3 illustrates how the growing periods differ among cultivars. *Table 3* also indicates the plant readiness of tubers at the time of planting of the trial, as well as the plant population and haulm count observed later in the growing period.

Cultivar performance and yield

The evaluation of new cultivars such as those in the Reitz cultivar trial, among others, delivers results regarding yield and marketing index. The marketing index of the cultivars in question are classed and sorted according to quality and size group, for example class 1 Large or class 2 Large medium.

Similar price comparisons are then made to market prices as obtained at the time of harvest. The performance of new cultivars cannot be based on one specific season only, as climate can vary from one year to the next. Therefore, cultivars

Table 3: Cultivar characteristics relating to growing period, plant readiness, plant population (%) and haulm counts.

Cultivar	Growing period (days)[1]		Plant readiness[2]	Plant population (%)	Haulms per plant	Haulms per ha
11Z49A1	Medium	(100)	3	83	4	81 974
11Z55A5	Medium	(100)	3	65	3	48 147
Allison	Medium to long	(120)	1	72	7	124 442
Alverstone Russet	Medium to long	(100)	1	70	4	69 134
Amany	Medium to long	(110)	3	83	3	61 480
Belmonda	Medium	(100-110)	3	56	5	69 134
CMK2012	Long	(120)	1	72	5	88 887
CMK2015	Long	(120)	1	65	4	64 196
Foxy	Short to medium	(90-100)	3	77	5	95 060
Kelly	Long	(120)	3	95	5	117 282
Lady Alicia	Medium	(95-100)	2	32	3	23 703
Lanorma	Short	(80-90)	3	83	3	61 480
Lilly	Medium	(100)	3	70	5	86 418
Mondial	Short to medium	(95-100)	1	79	3	58 517
Noya	Short	(80-90)	3	72	3	53 332
Palace	Long	(110-115)	1	74	4	73 085
Panamera	Short to medium	(95-100)	1	83	4	81 974
Prince	Long	(110-115)	1	81	2	39 999
Sababa	Medium to long	(110-115)	2	81	3	59 999
Sifra	Short to medium	(90-100)	2	70	4	69 134
Sound	Medium	(95-100)	1	70	7	120 985
Tyson	Short to medium	(90-100)	2	68	4	67 159

[1]General guidelines and categories (days from emergence to natural leaf senescence, depending on the season): Short = 70-90 days; Short to medium = 80-100 days; Medium = 90-110 days; Medium to long = 90-120 days; Long = 90-140 days.
[2]Plant readiness of tubers: 1 = Fresh; 2 = Slightly fresh; 3 = Plant ready; 4 = Slightly old; 5 = Old.

Figure 2: Rainfall in the 2022/23 season as well as long-term average rainfall.

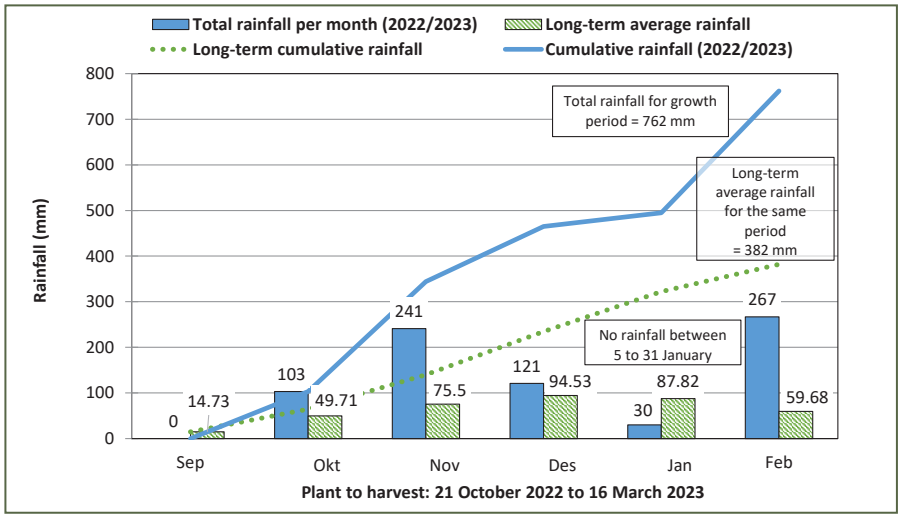


Figure 3: Minimum and maximum temperatures in the 2022/23 season as well as long-term temperatures.

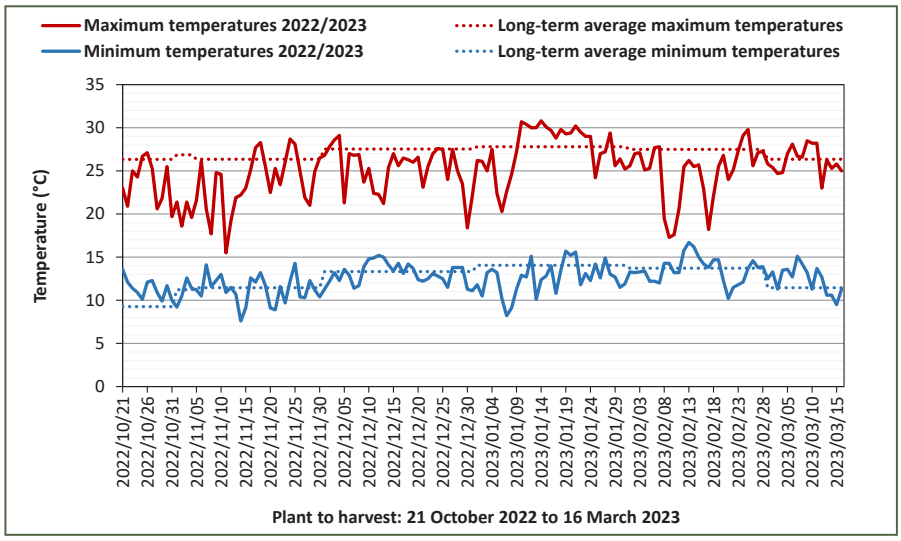
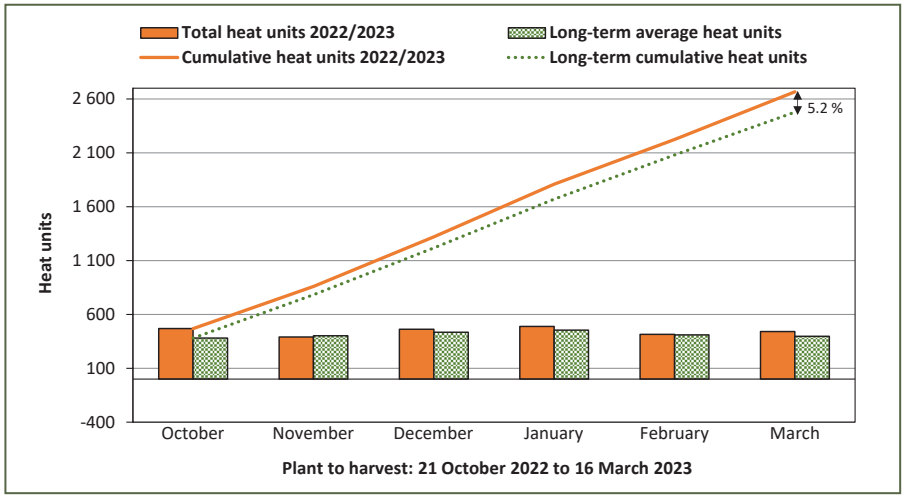


Figure 4: Heat units in the 2022/23 season as well as long-term average heat units.



**Total heat units determined specifically for potatoes as a crop (threshold temperature = 5°C). Calculated from hourly data.*

are tested across a number of seasons.

Seasonal aspects

As with any crops, aspects such as temperature, availability of water (whether good irrigation scheduling or rainfall) as well as heat units are all important factors that have a fundamental influence during the potato plant's growth period. Relevant daily and long-term weather data is obtained from a nearby Hortec weather station as well as a selected ARC weather station located as close as possible to the trial site.

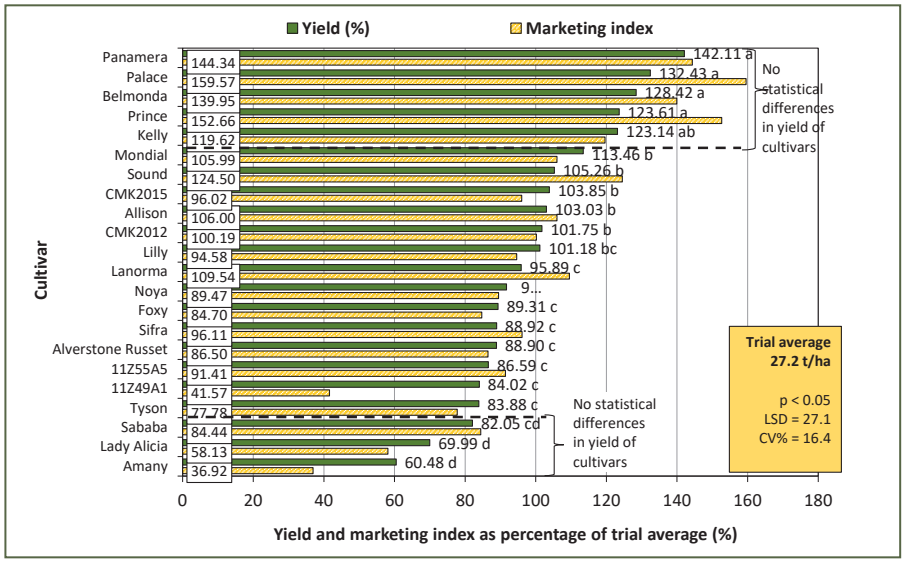
The 2022/23 season (*Figure 2*) was characterised by above-average rainfall. During the later stages of the growing period in January, no rainfall was recorded. This was followed by excessively high rainfall in the form of regular showers during the last month of growth. These observations were reflected in quality problems recorded as malformation.

Figure 3 contains minimum and maximum temperatures. Along with the months of above-average rainfall, the season was also characterised by major fluctuations in maximum temperatures.

The collection of heat units during a growing period is a vital aspect in the development of a potato plant. The trend of heat units available for the season's cultivar trial at Reitz seems to be higher than the long-term data for heat units, even though above average high temperatures were recorded in October prior to planting time. More heat units were accumulated later on in the growing period than the long-term data tendency reflects, despite the above-average rainfall and numerous overcast days throughout the season (*Figure 4*).

Yield data collected during harvest is subjected to statistical processing using the GenStat® program. The Tukey test of least significant differences (LSDs) is used to separate the average. The cultivar effect during this specific trial (*Figure 5*) was statistically significant

Figure 5: Total yield per cultivar as a percentage of the trial average.



**Values followed by the same letter do not differ significantly from one another.*

Figure 6: Size group distribution of each cultivar in the trial.

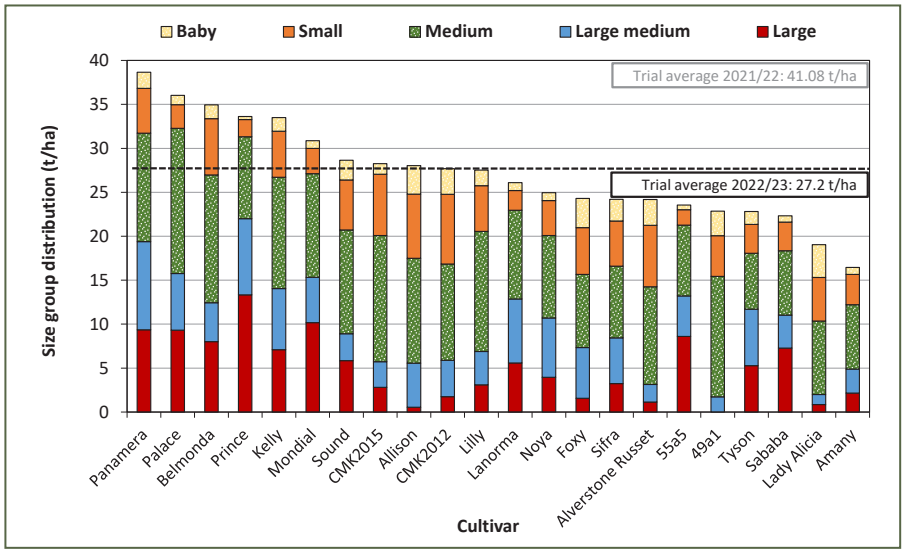
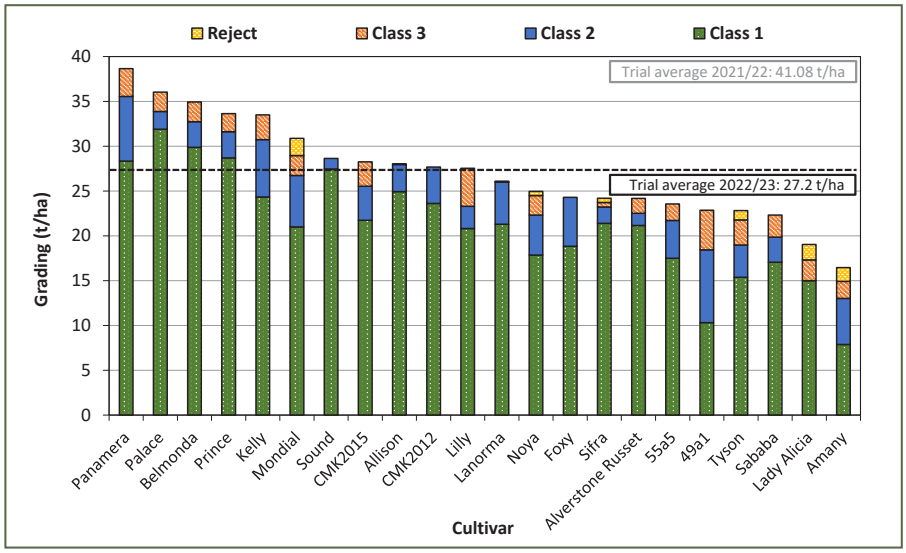


Figure 7: Grading of each cultivar in the trial.



(p<0.05) while the coefficient of variation was within limits (16.4%). These factors serve to indicate that the trial was performed as well as possible amid challenging weather conditions; and porcupine damage, the results are reliable.

Yields and marketing index

The yield of each of the cultivars is divided by the trial average (the trial average of all the cultivars is taken as 100%). This is used to determine a yield index, with each cultivar's performance in terms of yield then read as a percentage of the trial average.

During this season, the trial site was plagued by porcupines and consequently missing values had to be used to successfully analyse the data. The GenStat® program effectively yields values through calculations based on the available data set. It is important to take note of the fact that it could have an influence on the data outcomes.

The average yield of the trial for the 2022/23 season is 27.2 t/ha, which is substantially lower than the previous season's average of 41.08 t/ha. Several types of blight were also noticed to lesser and greater degrees on the cultivars during the season. Panamera, Palace, Belmonda, Prince and Kelly delivered the best yields with no statistical difference in the yield. Panamera, Palace, Belmonda and Prince obtained the best marketing index.

A good marketing index is ascribed to a higher yield of large potatoes and/or a good percentage of good quality. Size group distribution and grading are indispensable evaluations when studying a cultivar's marketability (*Figure 6* and *7*).

Quality and downgrading

The main reasons for downgrading are indicated in *Table 4*. Given the weather conditions, the quality of the cultivars was generally good and very little moth damage was reported. Due to the nature of the season, the quality of the cultivars in

Table 4: Main reasons for downgrading.

Cultivar	Malformation	Fissure scab	Moths	Insects	Common scab	Growth cracks	Stem-end rot
11Z49A1				x	x		
11Z55A5		x					
Allison							
Alverstone Russet							
Amany	x						
Belmonda							
CMK2012							
CMK2015							
Foxy							
Kelly					x	x	
Lady Alicia							
Lanorma				x			
Lilly							
Mondial	x		x			x	
Noya							
Palace			x				
Panamera	x						
Prince				x		x	
Sababa	x						x
Sifra							
Sound			x				
Tyson							

No internal defects such as hollow heart or brown spot were present in any of the cultivars.

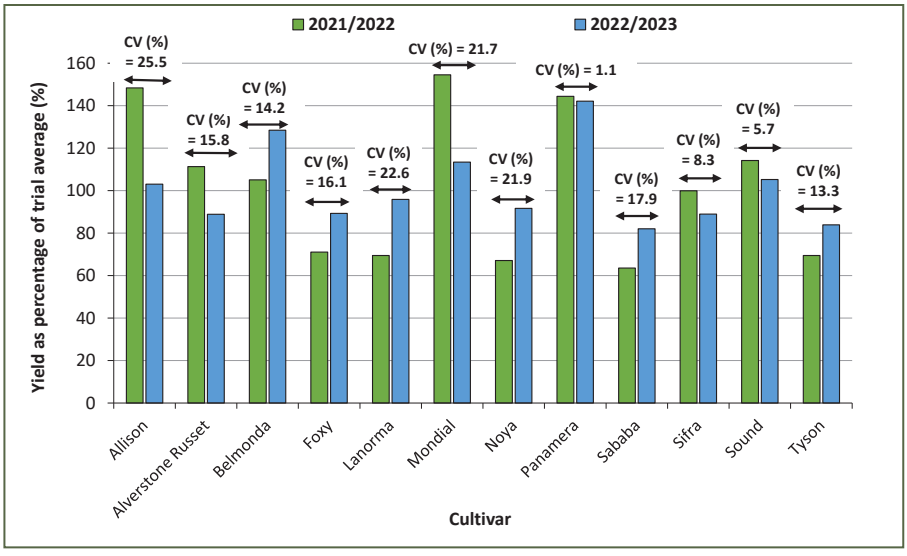
The average yield of the 2022/23 season's trial is 27.2 t/ha. This is substantially lower than the previous season's average of 41.08 t/ha.

Table 5: Processing characteristics of cultivars. (Performed by ARC-Roodeplaat).

Cultivar	Chip colour[1]	SG[2]	DM (%)[3]
11Z49A1	55	1.080	20.13
11Z55A5	45	1.075	19.24
Allison	48	1.080	20.14
Alverstone Russet	61	1.088	21.91
Amany	50	1.068	17.58
Belmonda	58	1.066	17.18
CMK2012	61	1.076	19.39
CMK2015	56	1.082	20.72
Foxy	49	1.077	19.56
Kelly	56	1.085	21.26
Lady Alicia	61	1.105	25.56
Lanorma	50	1.096	23.66
Lilly	48	1.072	18.62
Mondial	52	1.068	17.63
Noya	53	1.077	19.64
Palace	39	1.077	19.66
Panamera	50	1.070	18.06
Prince	54	1.085	21.26
Sababa	58	1.073	18.79
Sifra	45	1.077	19.56
Sound	50	1.074	18.99
Tyson	42	1.086	21.55

[1]Chip colour with a value >50 and without defects is acceptable to the dry chip industry.
[2]Specific gravity of >1.075 is acceptable for the processing industry.
[3]The percentage of dry matter is a calculated value:
*DM% = 24.182 + 211.04 * (SG-1.0988). The actual percentage value will differ slightly between varieties from this calculation value.*

Figure 8: Performance of cultivars included in the trial for both years, expressed as a percentage of the trial average.



Coefficient of variation (CV %) is included in the graph: A value which essentially portrays the degree of difference in performance of a specific cultivar over the number of years in question. The greater the CV % value, the greater the variation in the cultivar's performance over the number of years depicted on the graph.

the trial was affected by malformation and growth cracks.

The performance of cultivars vary from season to season. This is simply because climate is never the same from one season to the next. Therefore it is very important to consider consistent cultivar performance across a number of seasons. This trial was conducted over a period of two years and the variation among cultivars is illustrated in *Figure 8*.

Lastly, when looking at the internal quality of potatoes, an evaluation can also be done of its processing characteristics. To meet these processing characteristics, cultivars must meet a chip colour norm of >50 and a specific gravity (SG) of ≥1.075 (*Table 5*). Various cultivars exhibited the required chip colour and met the SG requirement.

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KwaZulu-Natal dryland cultivar trial conducted at Cedara over three growing seasons

By James Arathoon and Taslos Magubane, KwaZulu-Natal Department of Agriculture and Rural Development

The increasing use of irrigation for the production of potatoes and other crops is a global phenomenon. This trend is expected to continue due to climate change and the ever-increasing demand to produce more food from limited arable land to feed the growing world population. Consequently, the pressure on water sources will increase.

Currently, 83% of potato production fields in South Africa are irrigated. However, not all growers have access to irrigation water. Some areas do not receive sufficient rainfall for good yields to be obtained, and in some growing seasons the rainfall received may be below the quantities required for yields to be economically viable. Therefore, the identification of high-yielding cultivars with good water use efficiency is necessary.

Dryland conditions evaluated

A research project was implemented at the Cedara Research Station (S29° 32' 15 33, E30° 16' 09 19), which is situated in the moist mist-belt zone of the KwaZulu-Natal Midlands (900 to 1 400 m above sea level with 830 to 1 140 mm annual rainfall). The objective was to evaluate the performance of potato cultivars grown under dryland conditions. This report contains the results obtained from three growing seasons (2019/20 to 2021/22).

The trials were planted on on a Hutton soil (46 to 50% clay) on 19 September 2019, 17 September 2020 and 14 September 2021 at a seeding rate of 37 037 tubers/ha in rows spaced 0.9 m apart. Fertiliser was applied according to Fertrec recommendations for a 70 t/ha yield based on the results of soil analyses. Six fungicides and five insecticides were applied weekly in a rotation from ridging until 90% senescence.

The tubers were harvested two to three weeks after 100% senescence, then graded according to size (Large >250 g; Large medium 170 to 250 g; Medium 100 to 170 g; Small 50 to 100 g; Baby 5 to 50 g) and weighed to determine yield. The data was subjected to the analysis of variance (ANOVA) procedure in the statistical package, Genstat (22nd edition). Differences between treatment means were measured using Fisher's

Figure 1: Location of the Cedara Research Station potato cultivar evaluation trial.

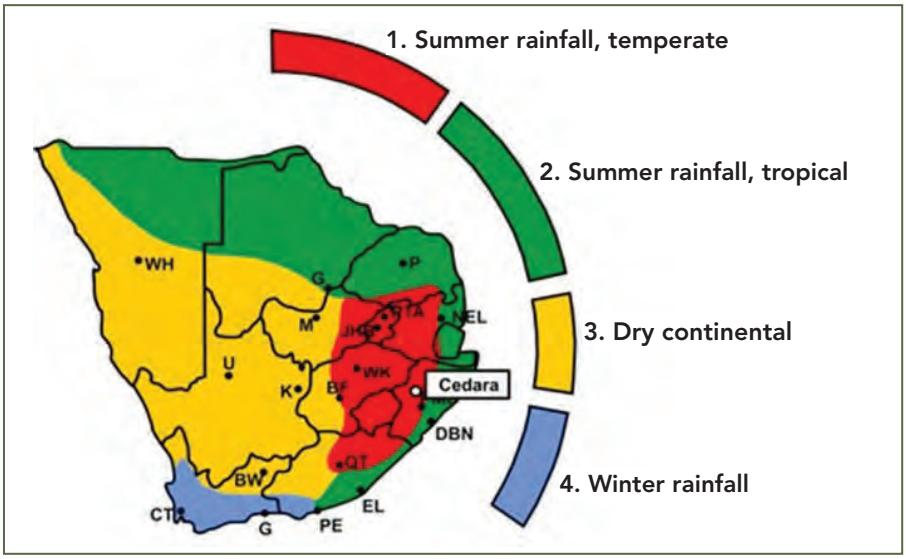


Figure 2: Monthly rainfall in the three growing seasons and the long-term monthly means at Cedara. (Long-term data: 93 years' data: 1923 to 2015, ARC-ISCW, Cedara)

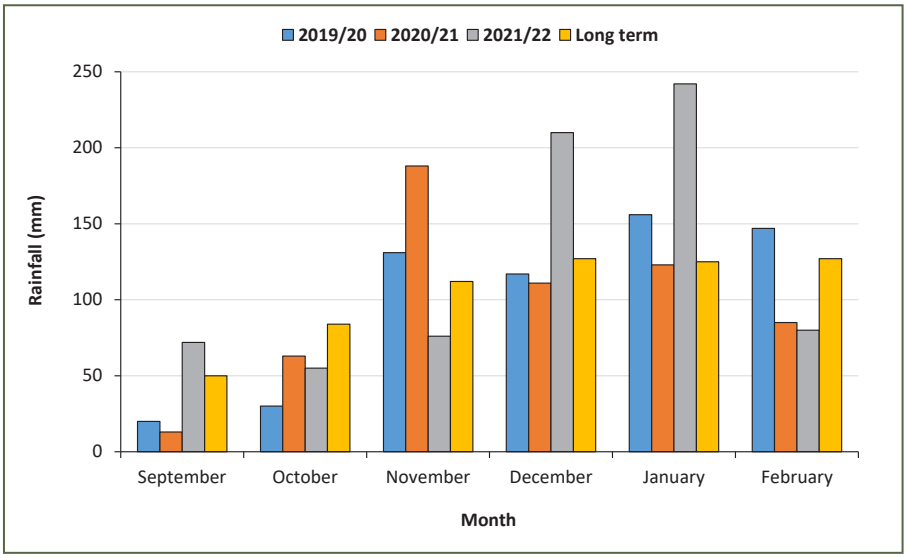


Figure 3: Monthly mean maximum and minimum temperatures in the three growing seasons and the long-term monthly means. (Long-term data: 93 years' data: 1923 to 2015, ARC-ISCW, Cedara).

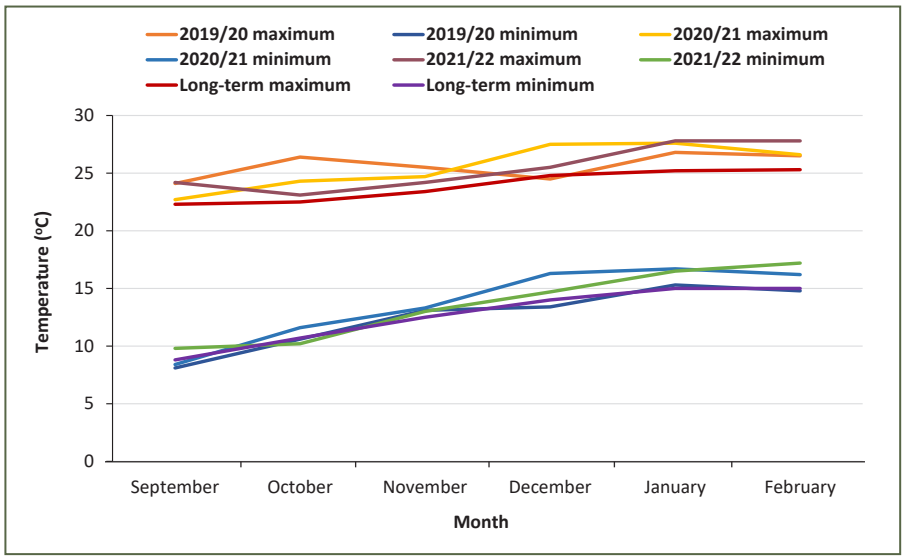
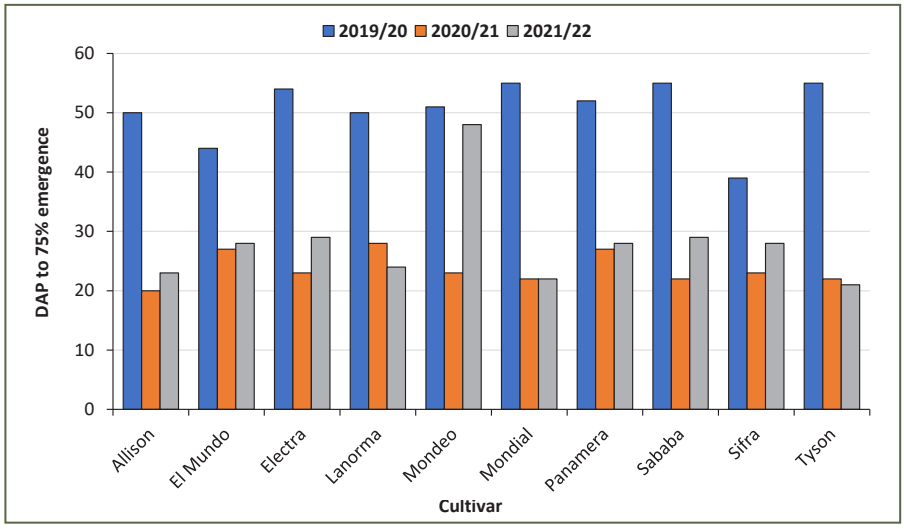


Table 1: Seed quality rating* at planting of the ten cultivars in the three growing seasons

Cultivar	2019/20	2020/21	2021/22	Mean
Allison	3.0	3.0	1.0	2.3
El Mundo	3.0	2.0	1.0	2.0
Electra	3.0	2.0	1.0	2.0
Lanorma	3.0	2.5	2.0	2.5
Mondeo	2.5	2.0	1.0	1.8
Mondial	3.0	3.0	1.0	2.3
Panamera	3.0	2.5	1.0	2.2
Sababa	3.0	3.0	1.0	2.3
Sifra	4.0	3.0	1.0	2.7
Tyson	3.0	3.0	2.0	2.7
Mean	**3.1**	**2.6**	**1.2**	**2.3**

*1 = Fresh seed; 3 = Well-sprouted; 5 = Over-sprouted.

Figure 4: Number of days after planting (DAP) to 75% emergence of the ten cultivars in the three growing seasons.



protected least significant difference (LSD) procedure at a 5% confidence level (P=0.05).

The importance of seed quality

The resilience of potato tubers to remain viable when very dry conditions are experienced for a long period after planting was evident in the 2019/20 growing season. Very little rain fell from planting until the last week in October and the mean maximum temperatures for September and October were considerably warmer than the long-term means (*Figures 2* and *3*).

This resulted in the cultivars taking a mean of 51 days after planting (DAP) to reach 75% emergence (*Figure 4*). However, Sifra took 39 days to emerge, but the plant stand was significantly lower (*Figure 5*), which resulted in a significantly lower yield compared to the other cultivars (*Figure 8*). The tubers of Sifra were slightly 'over-sprouted' at planting, whereas the tubers of the other cultivars were 'well-sprouted' (*Table 1*).

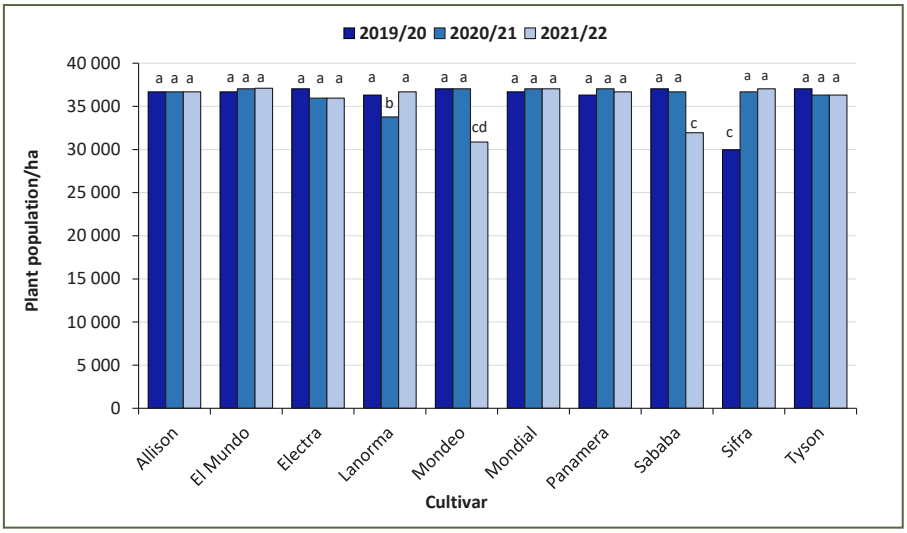
This indicates the importance of seed quality at planting, especially under dryland conditions. Despite the delayed emergence, the mean plant population was not significantly different to the means of the other two growing seasons.

Due to sufficient rain after planting in the 2020/21 and 2021/22 growing seasons, the cultivars took a mean of 24 and 28 DAP to reach 75% emergence, respectively (*Figure 4*). As the seed was fresher (less sprouted) in the 2021/22 growing season, 75% emergence occurred slightly later. In addition, the seedlings of Mondeo took 48 days to reach 75% emergence. The plant stand of Mondeo, together with that of Sababa, was significantly lower than the other cultivars (*Figure 5*). In the 2020/21 growing season, Lanorma had a significantly lower plant stand than the other cultivars. Overall, plant population was significantly positively correlated to yield.

Haulms per plant

A significant interaction was measured between the cultivars and seasons for

Figure 5: Plant population/ha of the ten cultivars in the three growing seasons.



Values with the same alphabetical letter are not significantly different.

Figure 6: Number of haulms/plant of the ten cultivars in the three growing seasons.

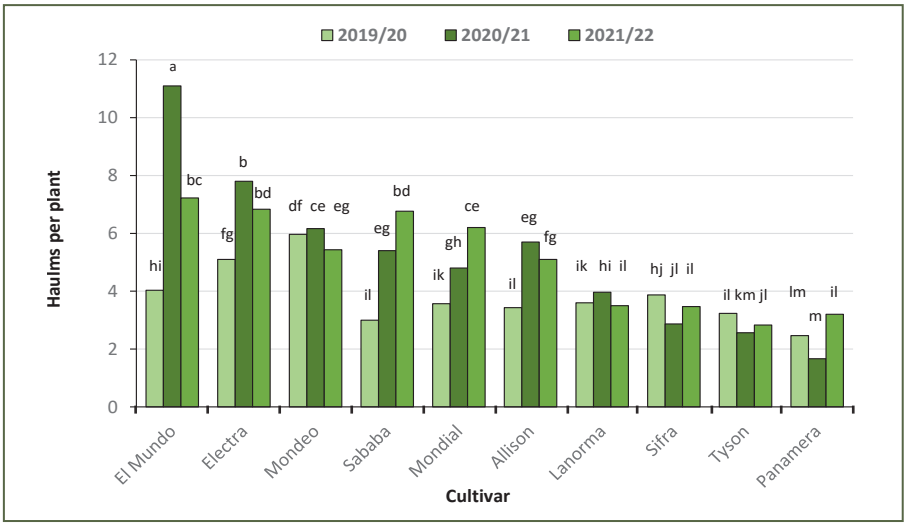
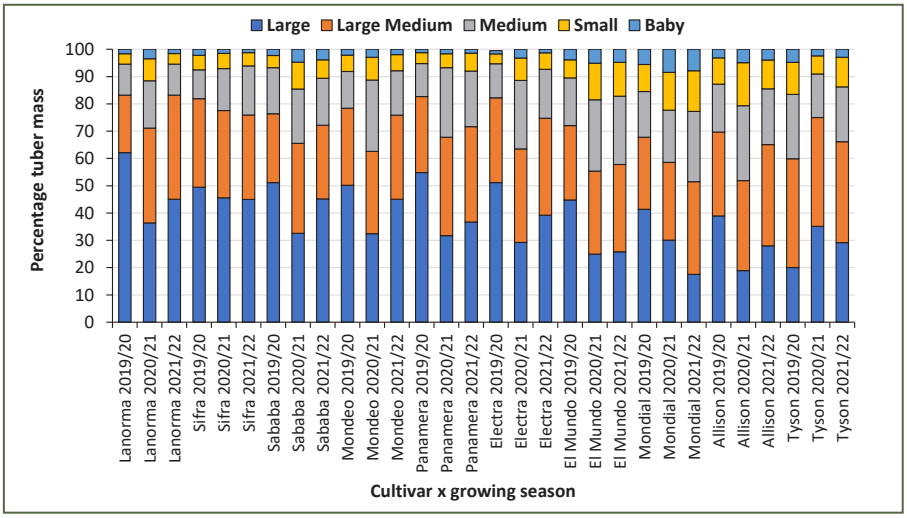


Figure 7: Percentage of tuber mass at the five grades for the ten cultivars in the three growing seasons.



the number of haulms produced per plant (*Figure 6*). The prolonged lack of rain after planting in the 2019/20 growing season reduced the energy levels in the tubers. This resulted in a significantly lower mean number of haulms per plant compared to the other two growing seasons.

While significant differences in the number of haulms per plant were measured between the three growing seasons for most cultivars, the numbers produced by Lanorma, Mondeo, Sifra and Tyson were not significantly different. El Mundo produced a significantly higher mean number of haulms per plant than the other cultivars. Panamera produced the lowest mean number of haulms per plant. Overall, the number of haulms per plant was significantly positively correlated to yield.

Table 2 indicates the number of days from planting to harvest of the cultivars in the 2019/20 growing season. Harvesting occurred approximately two weeks after 100% senescence. The number of days to 90% senescence was not recorded in the 2019/20 growing season but was in the 2020/21 and 2021/22 growing seasons. El Mundo and Panamera had the shortest and longest growth periods, respectively, in both seasons. The mean number of days to 90% senescence was significantly less in the 2021/22 growing season compared to the 2020/21 growing season (122 days versus 125 days).

Tuber size

Despite the delayed emergence of the seedlings in the 2019/20 growing season, the adequate rainfall received after emergence contributed to a significantly higher mean percentage mass of Large tubers compared to the latter two growing seasons (*Figure 7*).

This result could also have been due to fewer tubers produced per plant and therefore less competition, which allowed the tubers to enlarge. A significant interaction was measured for the percentage mass of Large tubers between the growing seasons and cultivars. However, no significant differences were measured for Sifra

between the growing seasons. The highest mean percentage mass of Large tubers was produced by Lanorma, but the value was not significantly different to those of Sifra, Sababa and Mondeo.

No significant interaction was measured between the seasons and cultivars for the percentage mass of Large Medium tubers. A significantly lower mean percentage of Large Medium tubers was measured in the 2019/20 growing season. Tyson had the highest mean percentage of Large Medium tubers, but the value was not significantly different to those of Allison and Electra. Overall, the mass percentages of all grades were not significantly correlated to yield.

Good yields produced

The rainfall received from tuber initiation to the end of bulking in the three growing seasons was sufficient to ensure that good yields were produced (*Figure 8*). Due to the slow emergence of the cultivars and the fewer haulms/plant in the 2019/20 growing season, the mean yield (49.42 t/ha) was significantly lower than in the 2020/21 growing season (55.10 t/ha), during which the rainfall was more evenly distributed.

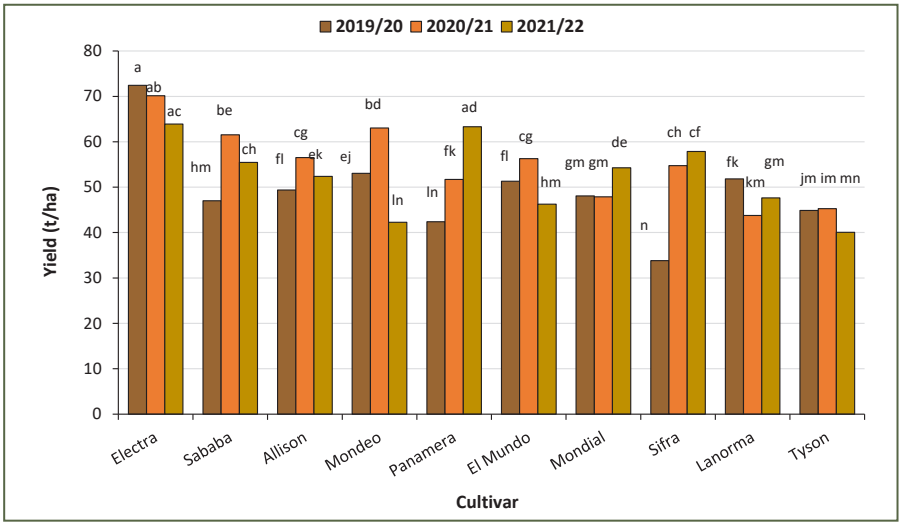
A dryland potato cultivar evaluation trial at the Cedara Research Station.

Although a significant interaction was measured for yield between the growing seasons and the cultivars, no significant differences were measured for Allison, Electra, Lanorma and Tyson, indicating that these cultivars had greater yield stability despite the climatic variations between the growing seasons. Electra produced the highest yields in all three growing seasons. Tyson produced the lowest mean yield.

Table 2: Number of days after planting to harvest of the ten cultivars in the 2019/20 growing season and to 90% senescence in the 2020/21 and 2021/22 growing seasons.

Cultivar	2019/20	2020/21	2021/22	Mean
	Harvest	90% senescence		
	(DAP)	(DAP)		
Allison	167	124.3 ef	116.3 hi	**120.3**
El Mundo	160	112.0 ij	107.5 j	**109.7**
Electra	167	129.3 ce	119.0 gh	**124.2**
Lanorma	174	127.0 de	128.0 de	**127.5**
Mondeo	167	134.0 ac	132.0 bd	**133.0**
Mondial	174	131.7 bd	137.3 a	**134.5**
Panamera	167	134.0 ac	136.7 ab	**135.3**
Sababa	167	121.7 fg	116.0 hi	**118.8**
Sifra	154	119.0 gh	119.3 gh	**119.2**
Tyson	154	114.3 hi	107.7 j	**111.0**
Mean	**165**	**124.7**	**122.0**	**123.4**
LSD (P<0.05) season			1.641	
LSD (P<0.05) cultivar			3.669	
LSD (P<0.05) season x cultivar			5.188	
CV%			2.5	

Figure 8: Yield of the ten cultivars in the three growing seasons.



Conclusions and recommendations

When seed potato tubers lie dormant in very dry soil for an extended period after planting, the seeds must be of good quality to ensure that they remain viable.

Due to high rainfall in the KwaZulu-Natal Midlands, good yields (>50 t/ha) are obtainable under dryland conditions with most cultivars. However, the performance of the ten cultivars evaluated may have varied considerably compared to the results obtained if they were grown under much drier conditions.

Electra produced the highest yields in all three growing seasons and therefore it is recommended for growing under dryland conditions in the KwaZulu-Natal Midlands.

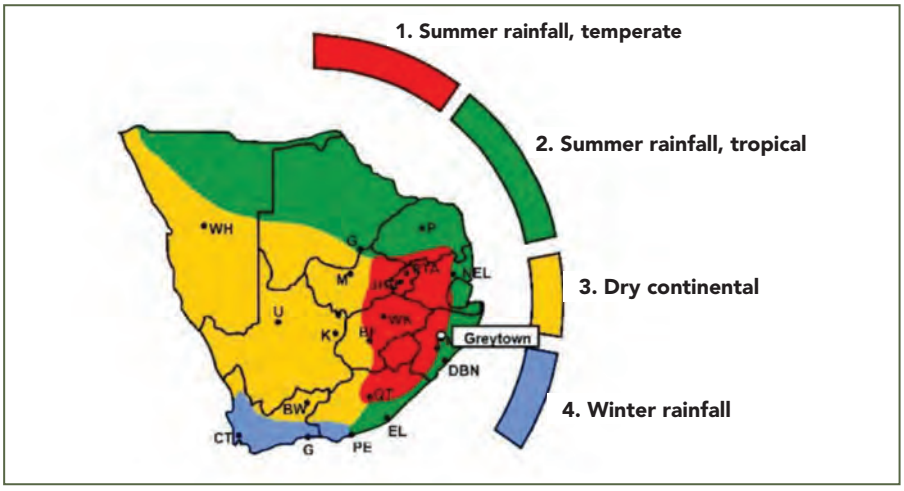
For more information, contact James Arathoon at james.arathoon@kzndard.gov.za or visit *www.kzndard.gov.za.*

KwaZulu-Natal cultivar trial under irrigation at Greytown in 2022/2023

By Enrike Verster, Potatoes SA

The KwaZulu-Natal production region produces approximately 5% of the South African potato crop. The region plants potatoes both under irrigation and on dryland, and cultivates them for the seed, table and processing markets. The main cultivars earmarked for the table and processing markets include Mondial, Valor and Sifra in winter, and Valor, Mondial, Fianna, Up-to-Date and Lanorma in summer. Popular cultivars for seed potatoes produced in this area are Mondial, Valor and FL2108.

Figure 1: Location of Greytown in the KwaZulu-Natal production region.



Trial location and design

This trial was conducted at Greytown, a town situated 1 155 m above sea level on the banks of the Umvoti River in a fertile timber-producing area of KwaZulu-Natal. Greytown is located in a warm and temperate area with a significant annual average rainfall of 688 to 1 140 mm throughout the year (*Figure 1*). Greytown has two production seasons, namely a winter season with planting taking place from February to July, and a summer season with planting that takes place from August to January.

The trial was carried out in sandy loam soil and laid out in a randomised block design with three

The cultivars Allison, Mondial, Panamera, Noya and Lanorma statistically produced the highest yields.

Table 1: Summary of technical information regarding the trial site and layout.

Farm	**Golden Grow**
Planting date	23 August 2022
Harvesting date	24 January 2023
Irrigation/ dryland	Irrigation
Double or single rows	Two single rows
Leaf senescence	Chemical
Intra-row spacing	0.75 m
Inter-row spacing	30 cm
Trial site per unit	15 m^2
Population density	44 444 plants/ha

Figure 2: Rainfall (2022/23 season) and long-term average rainfall.

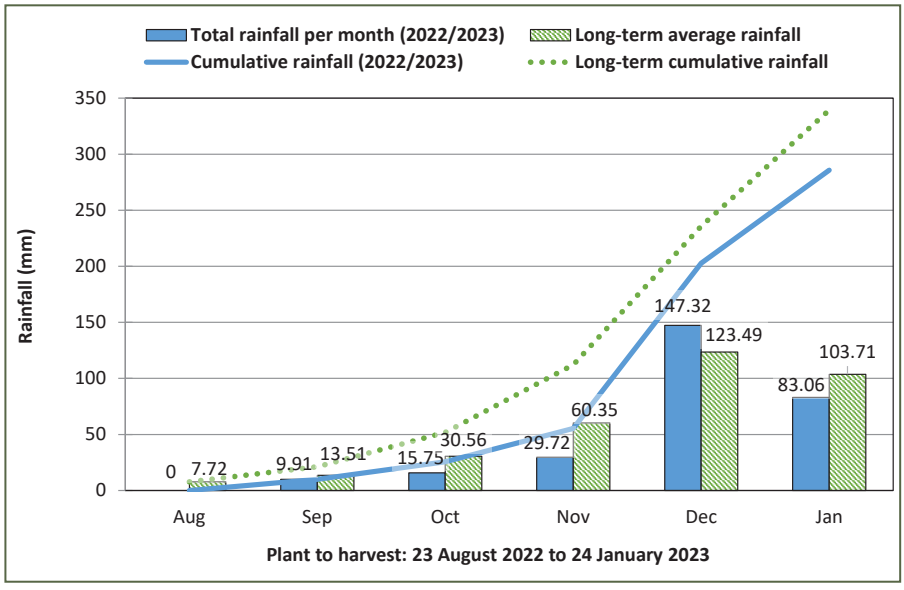
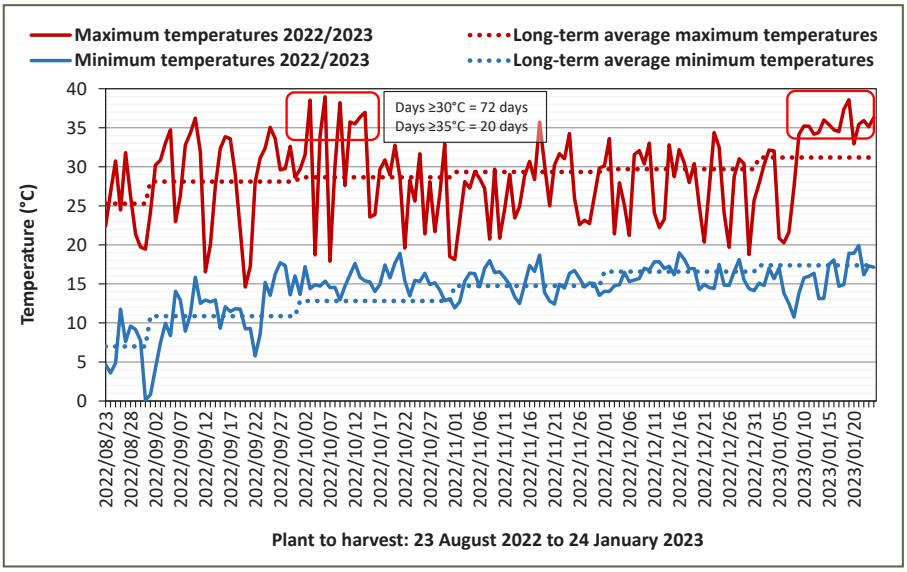


Figure 3: Minimum and maximum temperatures (2022/23 season) as well as long-term average.



replications per cultivar. Additional technical information regarding the trial site and layout is summarised in *Table 1*. It is important to note that growth periods can affect the crop yield of cultivars. Growth periods are defined as the number of days from emergence to leaf senescence, depending on the season.

The variation between cultivars during the four growth phases depends on the environment and management practices. This varies among cultivars due to different growth periods combined with the factors mentioned previously. The cultivars, plant readiness of tubers, population density (%) and haulm count of this trial are indicated in *Table 2*.

Temperature and weather

Temperature, daylight length and water (be it rainfall and/or irrigation scheduling) are the most important abiotic factors influencing the growth, yield and quality of potatoes. To determine the adaptability of new cultivars in the Greytown area, it is important to consider these factors when evaluating the performance of different cultivars. It is also important that the cultivars are evaluated across several seasons since climate differs from one season to the next.

Daily weather data was obtained from the Agricultural Research Council's (ARC) Ivala Muden Station (-28.97029, 30.37931) located 30 km from the trial site. The rainfall trend of the 2022/23 growing season was lower than the long-term average trend with most months receiving less rainfall in total than usual (*Figure 2*). However, intense rain showers were reported as challenges experienced during the growing season despite the moderate rainfall reflected in the available weather data.

The minimum as well as maximum temperatures (*Figure 3*) for the 2022/23 growing season followed the same trend as in previous years, with the exception of extremely high maximum temperatures (>35°C) recorded in early to mid-October and again in January.

The minimum temperatures, on the other hand, were slightly higher at the end of September until November compared to the long-term data. Significant fluctuating temperatures throughout the growing season were also observed, with temperatures higher than 35°C for 20 days and temperatures higher than 30°C for 72 days in total throughout the growing season.

Heat units are also an important factor to consider in terms of plant growth. The trend of heat units for the 2022/23 growing season followed more or less the same trend as the long-term average, as is depicted in *Figure 4*. At the end of the season, the heat units of the 2022/23 growing season were 1.9% higher than the long-term cumulative heat units.

Data relating to yields

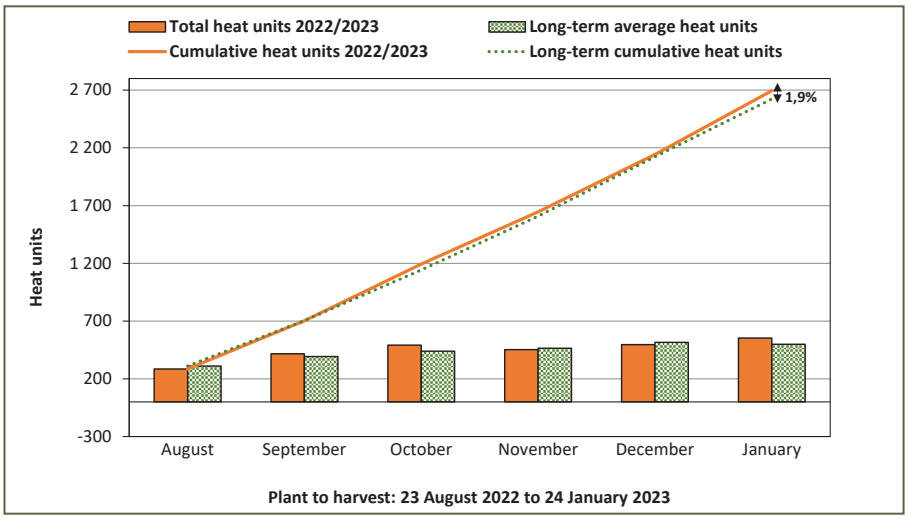
Yield data collected during harvest was subjected to statistical processing using the GenStat® program. The Tukey test of least significant differences (LSD) was used to separate the mean. The cultivar effect of the 2022/23 trial (*Figure 5*) was statistically significant ($p < 0.05$) in terms of yield, while the coefficient of variation (CV) was within specifications (19.8%). This indicates that the trials were well executed and that the results are reliable.

The average yield for the 2022/23 season was 42.16 t/ha whereas the previous season's was 65.9t/ha. This may largely be attributed to environmental challenges – despite the seemingly moderate rainfall per month as recorded in the available weather data, large and intense rainfall showers contributed to challenges during the growing season.

Cultivar performance

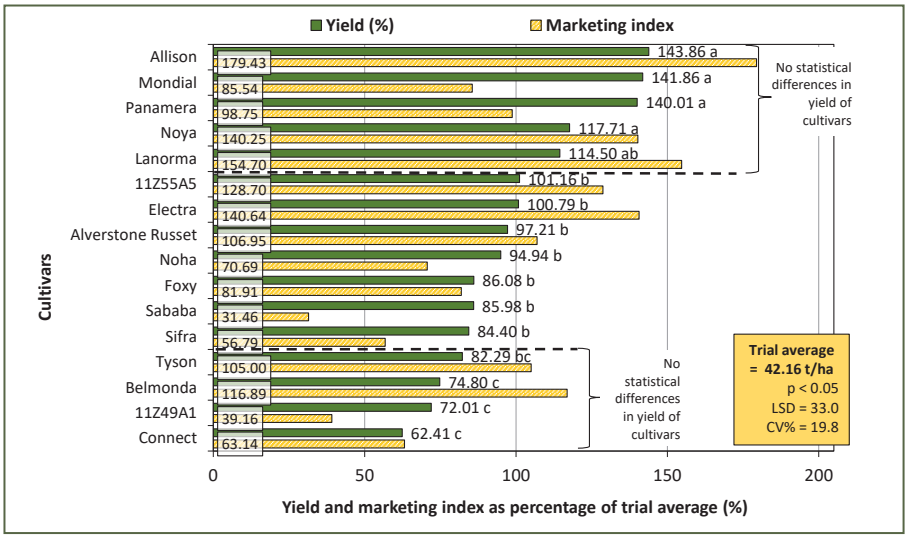
During the 2022/23 trials (*Figure 5*) the cultivars Allison, Mondial, Panamera, Noya and Lanorma statistically produced the highest yields. To determine cultivar performance in terms of yield and quality, the researchers utilised yield, size-group distribution and class to calculate a marketing index according

Figure 4: Heat units (2022/23 season) as well as long-term average.



**Total heat units specifically calculated for potatoes as a crop (threshold temperature = 5°C). Calculated from hourly data.*

Figure 5: Total yield and marketing indices per cultivar as a percentage of the trial average.



**Values followed by the same letter do not significantly differ from one another.*

The variation between cultivars during the four growth phases depends on the environment and management practices.

Table 2: Growing periods, plant readiness, population density (%) and haulm count.

Agent	Cultivar	Growth period (days)[1]		Plant readiness[2]	Population density (%)[3]	Haulms per plant	Haulms per hectare
GWK	11Z49A1	Medium	(100)	2	76	3.0	67 555
GWK	11Z55A5	Medium	(100)	3	74	7.0	65 777
	Allison	Medium to long	(120)	3	74	2.9	65 777
	Alverstone Russet	Medium to long	(110-115)	3	74	4.6	65 777
GWK	Belmonda	Short to medium	(100)	1	72	2.3	63 999
GWK	Connect	Medium to long	(120)	3	67	4.7	59 555
	Electra	Medium	(110)	2	85	3.2	75 555
RSA	Foxy	Short to medium	(90-100)	4	94	2.1	83 555
GWK	Lanorma	Short	(80-90)	1	94	6.2	83 555
	Mondial	Short to medium	(95-100)	3	88	2.9	78 221
GWK	Noha	Long	(120)	1	85	1.5	75 555
GWK	Noya	Medium	(100)	2	74	2.8	65 777
	Panamera	Long	(120-125)	3	97	3.3	86 221
	Sababa	Medium to long	(110-115)	3	72	5.3	63 999
	Sifra	Short to medium	(90-100)	3	72	5.6	63 999
	Tyson	Short to medium	(90-100)	3	67	3.2	59 555

[1]General guidelines and categories (days from emergence to natural leaf senescence, depending on the season): Short: 70-90 days; Short to medium = 80-100 days; Medium = 90-110 days; Medium to long = 90-120; Long = 90-140 days.
[2]Plant readiness of seed potatoes: 1 – Fresh; 2 – Slightly fresh; 3 – Ready for planting; 4 – Slightly old; 5 – Old.
[3]Population density was determined on one replication of each cultivar, which consisted of two rows with 34 plants, equating to 68 plants per unit.

Table 3: Processing characteristics and internal quality of the cultivars in the 2022/23 trial (Conducted by ARC-Roodeplaat).

Cultivar	Chip colour[1]	SG[2]	Dry matter (%)[3]	Hollow heart	Brown spot
11Z49A1	48	1.070	18.1		
11Z55A5	60	1.077	19.5		
Allison	50	1.069	17.9		
Alverstone Russet	35	1.083	20.8		
Belmonda	50	1.072	18.5		
Connect	38	1.060	16.1		
Electra	59	1.062	16.3		
Foxy	37	1.057	15.3		x
Lanorma	61	1.062	16.4		
Mondial	35	1.060	16.0		
Noha	36	1.064	16.8		x
Noya	35	1.072	18.6	x	
Panamera	50	1.073	18.7		
Sababa	49	1.063	16.5		
Sifra	35	1.065	17.0		
Tyson	56	1.069	17.9		
≥ Norm (acceptable for processing)			<Norm (unacceptable for processing)		

[1]Chip colour with a value of >50 and without defects is acceptable for the chip industry.
[2]Specific gravity of >1.075 is acceptable for the processing industry.
[3] The percentage of dry matter is a calculated value: DM % = 24.182+211.04(SG-1.0988). The actual percentage value will differ slightly between varieties based on this calculating value.*

Figure 6: Size group distribution of each cultivar during final harvest.

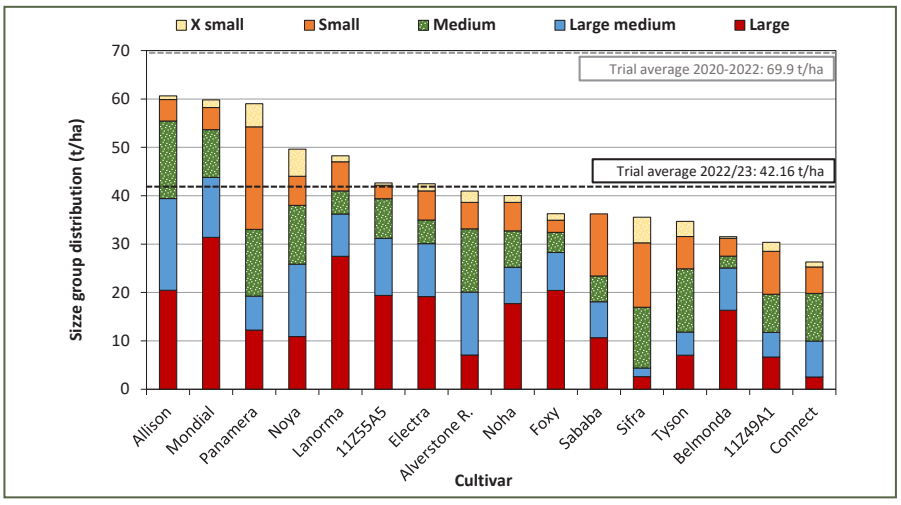


Figure 7: Grading of each cultivar during final harvest.

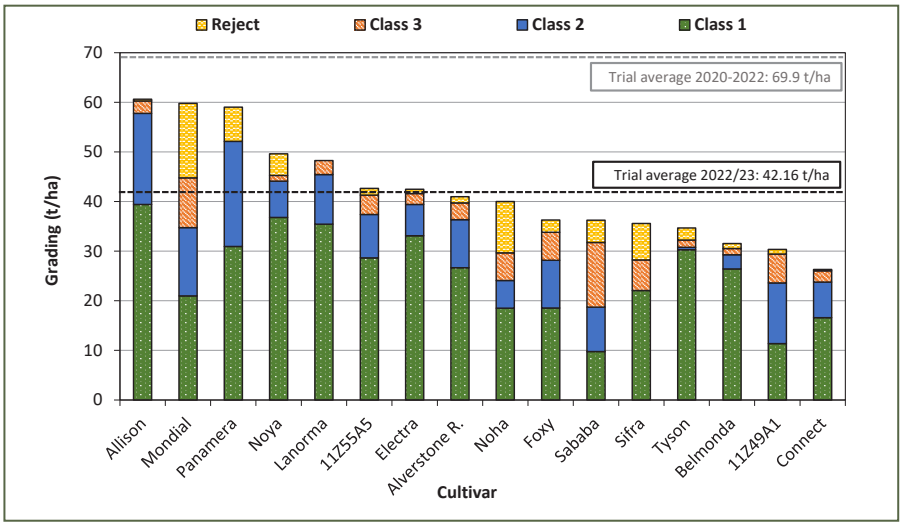
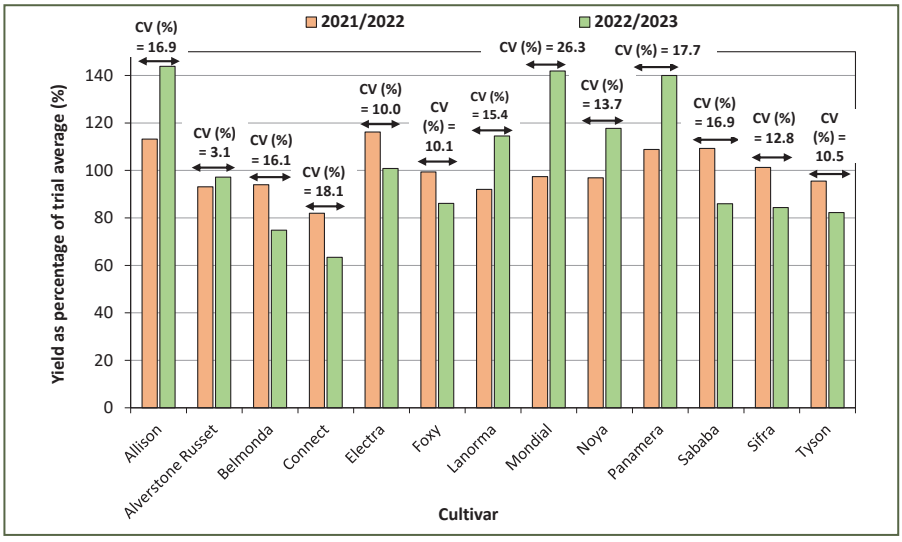


Figure 8: Performance of cultivars included in the trial for the past two years (illustrated as a percentage of the trial average).



Coefficient of variation (CV%) is included on the graph: A value that essentially depicts the margin of difference in the specific cultivar's performance over the years indicated on the graph. The greater the CV % value, the greater the cultivar's performance variance over the number of years indicated on the graph.

to the average market prices for the week of harvest (*Figure 5*). Allison, Lanorma, Electra and Noya produced the highest marketing indices which is the result of a high percentage of Large tuber size distribution (*Figure 6*) and a high percentage of Class 1 grading (*Figure 7*).

These factors are therefore important in ensuring an optimal, economically marketable yield. The main reasons for the downgrading of potatoes to lower classes were recorded as common scab, mechanical damage and damage inflicted by insects.

When looking at the performance of cultivars, it is important to take into account results over several seasons as each season differs from the next and cultivars are subjected to different challenges and conditions. *Figure 8* illustrates the performance of cultivars that had been entered into the trial for the past two seasons.

The internal quality of the potatoes needs to be evaluated to determine the purpose of the specific cultivar at the end of the day. This includes important factors such as processing properties, specific gravity (SG) and the identification of the cultivars' proneness to internal defects (hollow heart and brown spot) as contained in *Table 3*.

During the 2022/23 growing season, only the cultivar 11Z55A5 met the chip colour standard of >50 for processing, as well as the SG standard of ≥1.075. Alverstone Russet had the correct SG requirements and Electra, Lanorma and Tyson had the correct chip colour. In terms of internal defects, the cultivars Foxy and Noha had internal brown spot and Noya had hollow heart.

Special thanks to Golden Grow as well as Chantel du Raan, Damien Da Cal and Louis Pretorius of Potatoes SA.
For more information, contact Enrike Verster at enrike@potatoes.co.za.

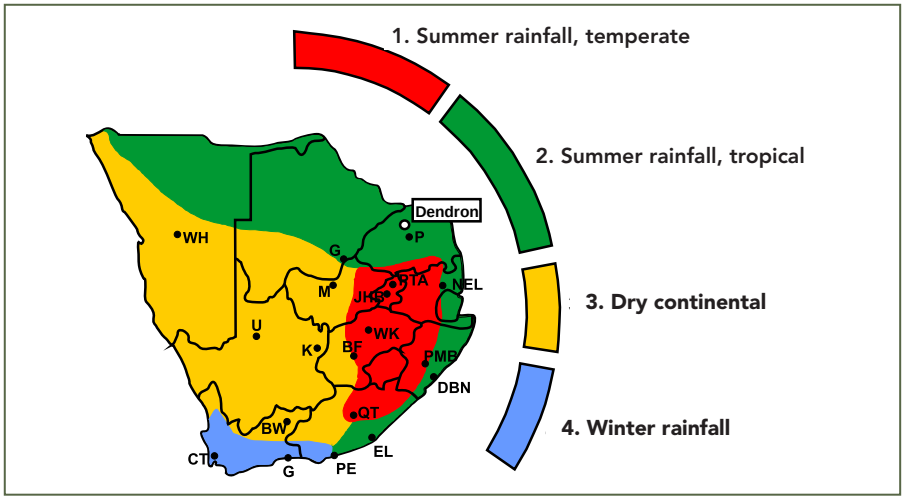
Limpopo cultivar trial under irrigation at Dendron in 2022

By Chantel du Raan, Potatoes SA

The Limpopo potato production area currently produces approximately 22% (2019 harvest) of South Africa's total potato production. Potatoes in this region are planted under irrigation and potato cultivation is aimed at table potato production and processing. The main cultivars produced include Mondial, Valor and Sifra.

Trials are being conducted at Dendron, a small Bushveld town situated along the R521, some 61 km northwest of Polokwane. Dendron is a tropical rainfall area with an annual average rainfall of 403 mm/year (*Figure 1*).

Figure 1: Location of Dendron in the Limpopo production area.



The area is characterised by very long, hot and partly cloudy summers, whereas the winters are short, cool and dry. One reason for this region's large contribution to the industry is the fact that it has two production seasons. This includes an early planting from January to March, while the main planting season is from April to July.

The 2022 trial was conducted in sandy loam soil in a randomised block design with three replications. Additional technical information regarding the trial site and layout is summarised in *Table 1*.

It is important to note that growth periods can affect cultivar yields. Growth period is defined as the number of days from emergence to leaf senescence, depending on the season. The exact timing of the four growth phases depends on

Table 1: Summary of technical information regarding the trial site and layout.

Farm	**Zandput Farm**
Producer	Mossie Jongbloed
Planting date	11 May 2021
Harvest date	30 September 2021
Irrigation/dryland	Irrigation
Double or single rows	Two single rows per cultivar
Leaf senescence	Natural
Inter-row spacing	0.75 m
Intra-row spacing	0.30 m
Trial site per unit	18 m^2
Plant density	44 444 plants/ha

Figure 2: Rainfall during the 2022 growing season as well as the long-term average rainfall.

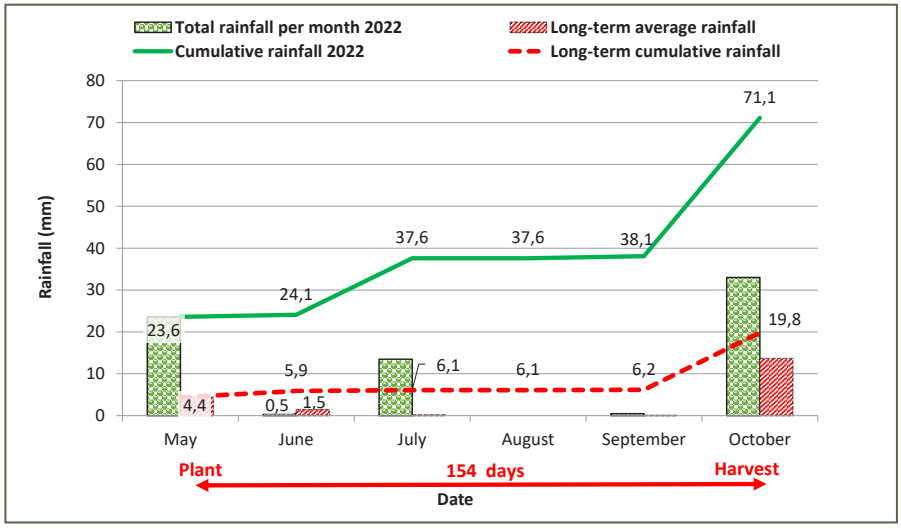
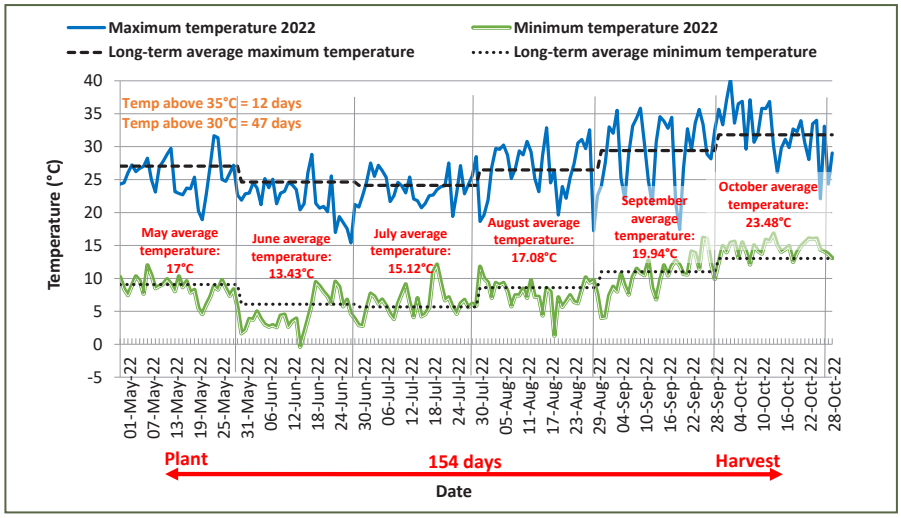


Figure 3: Minimum and maximum temperatures (°C) during the 2022 growing season as well as long-term average temperatures.



the environment and management practices, which vary between localities as well as cultivars due to the different growth periods, among others. The cultivars, plant readiness of tubers, plant density (%) and haulm count of this trial are contained in *Table 2*.

Factors influencing potato quality

Temperature, daylight length and water are the most important abiotic factors influencing the growth pattern, yield and quality of potatoes. To determine the adaptability of new cultivars in the Dendron environment, these factors must be taken into consideration when evaluating the performance of different cultivars.

It is also important to evaluate the cultivars for several seasons, since climate differs from one season to the next. Daily as well as long-term weather data (last five years) was obtained from the Zandput station at the trial site. Below-average rainfall was recorded throughout the 2022 growing season. Cumulative rainfall for the growing reason (71.1 mm) was higher than the average cumulative long-term rainfall of 19.8 mm (*Figure 2*).

Both the minimum and maximum temperatures (*Figure 3*) varied substantially throughout the 2022 growing season. During June both the maximum and minimum temperatures were much lower compared to previous years (long-term data). Low temperatures were recorded during May (4.57°C), June (-0.38°C) as well as August (1.3°C). With regard to maximum temperatures, there was a period of 12 days during which temperatures exceeded 35°C and 47 days where temperatures were above 30°C.

Heat units are another important factor to consider, as the development of the plant is mainly based on the collection of heat units. It is therefore presumed that the plant must collect a certain number of heat units to complete a development phase. The heat units of the 2022 growing season showed

Table 2: Characteristics regarding growth period, plant readiness, plant density (%) and haulm count for each cultivar in 2022.

Agent	Cultivar	Growth period (days)[1]	Plant readiness[2]	Plant density (%)	Haulms per plant	Haulms per ha
GWK	**Belmonda**	Short	2	61.8	4.1	112 612
GWK	**Connect**	Medium to long	1.5	85.3	1.9	72 030
RSA	**Foxy**	Short to medium	4	88.2	5.2	203 838
GWK	**Lanorma**	Short	3	85.3	3.4	128 896
Wel grow	**Mondial**	Medium to long	4	79.4	3.2	112 923
Wel grow	**Panamera**	Long	3	100	2.5	111 110
Wel grow	**Sababa**	Medium to long	3	88.2	1.8	70 559
Wel grow	**Sifra**	Short to medium	1	82.4	2.1	76 906
First Potato Dynamics	**Sound**	Medium	5	79.4	6.6	232 904
Wel grow	**Tyson**	Short to medium	2	82.4	2.1	76 906

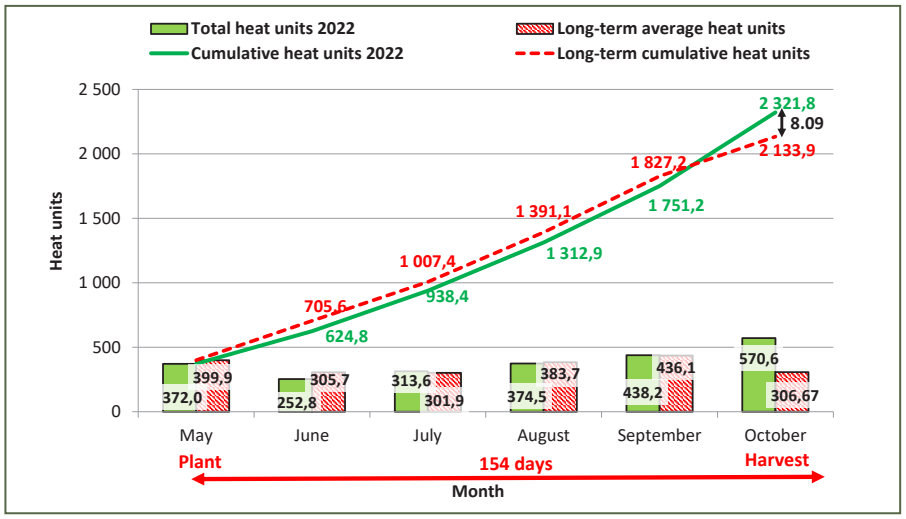
[1] General guidelines and categories (days from emergence to leaf senescence, depending on the season): Short: 70-90 days; Short to medium = 80-100 days; Medium = 90-110 days; Medium to long = 90-120 days; Long = 90-140 days.
[2] Plant readiness of tubers: 1 - Fresh; 2 - Slightly fresh; 3 - Plant ready; 4 - Slightly old; 5 - Old.

Table 3: Main reasons for downgrading during the 2022 Dendron harvest.

Cultivar	Thumbnail cracks	Growth cracks	Insect damage	Mechanical damage	Malformation	Moth damage	Skinning	Rhizoctonia	Potato scab	Sand split	Silver scurf and black spots	Greening	Rot	Water scab
Belmonda						X								
Connect				X							X	X		
Foxy											X	X		
Lanorma						X					X			
Mondial					X		X		X		X			
Panamera		X				X	X				X	X		
Sababa					X	X				X				X
Sifra						X						X		
Sound	X										X			
Tyson						X							X	

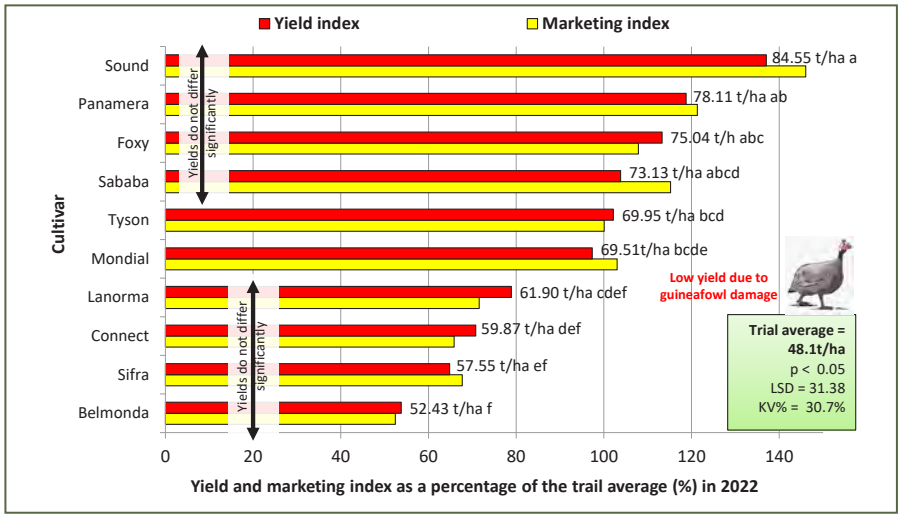
<5% incidence 5 tot 15% incidence >15% incidence

Figure 4: Heat units during the 2022 growing season as well as long-term average heat units.



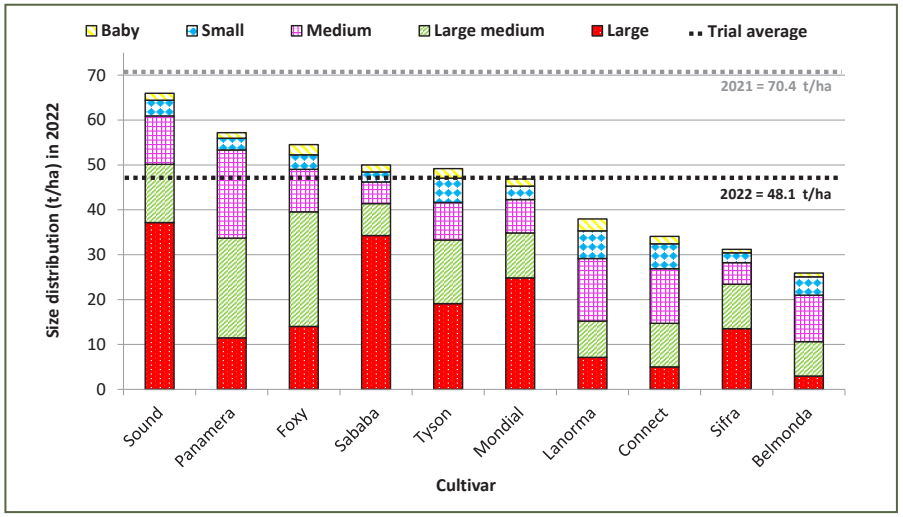
**Total heat units determined specifically for potatoes as a crop (threshold temperature = 5°C). Calculated from hourly data.*

Figure 5: Total yield and marketing index per cultivar as a percentage of the trial average.



**Values followed by the same letter are not significantly different from one another.*

Figure 6: Size group distribution of each cultivar during final harvest.



the same trends as the long-term data with the exception of October (*Figure 4*). Towards the end of the season the cumulative heat units for the 2022 growing season were 8.09% lower than the cumulative long-term heat units.

Cultivar performance and yields

The yield data was statistically processed using the GenStat® program, and the mean was separated using the Tukey test of least significant differences (LSD). The cultivar effect during the 2022 trials (*Figure 5*) was statistically significant ($p<0.05$) in terms of yield, while the coefficient of variation (CV) was acceptable (30.7%). This indicates that the trials were well executed, and the results are reliable.

The average yield of the cultivar trial for the 2022 season was 48.1 t/ha. This is much lower than in previous years and can be ascribed to damage by guineafowls. During the 2022 trial (*Figure 5*) the cultivars Sound, Panamera, Foxy and Sababa delivered the highest yields. Sound, Panamera, Foxy, Sababa and Tyson delivered higher yields than the trial average (48.1 t/ha).

Size distribution and grading are also used to class potatoes, and are therefore important factors to consider in order to ensure economical, optimally marketable yields. Yield multiplied by the current price which is determined by size distribution and grading, equates to the marketing index (*Figure 5*).

Sound achieved the highest marketing index which can be ascribed to a combination of a high percentage of large tubers (*Figure 6*) and a high percentage of Class 1 (*Figure 7*) potatoes delivered by the cultivar. Thus, size distribution and grading are factors used to class potatoes, making it important factors to also consider in order to ensure an optimal, economic, marketable yield. *Figure 6* illustrates the size distribution, *Figure 7* the yield grading, and *Table 3* the main reasons

Table 4: Processing characteristics and internal quality for the 2022 trial. (Conducted by the ARC-Roodeplaat)

Cultivar	SG[1]	Dry matter (%)[2]	Hollow heart	Brown spot
Belmonda	1.077	19.61	–	–
Connect	1.075	19.12	–	–
Foxy	1.061	16.17	–	–
Lanorma	1.076	19.44	–	–
Mondial	1.073	18.77	–	–
Panamera	1.065	17.00	–	–
Sababa	1.076	19.43	–	–
Sifra	1.071	18.41	–	–
Sound	1.079	19.99	–	–
Tyson	1.064	16.93	–	–
≥ Norm (acceptable for processing)		< Norm (unacceptable for processing)		

[1]Specific gravity of >1.075 is acceptable for the processing industry.
*[2]The percentage of dry matter is a calculated value: DM% = 24.182 + 211.04 * (SG-1.0988). The actual percentage value will differ slightly between varieties based on this calculating value.*

for downgrading of the various cultivars indicated.

Cultivar performance

It is important to consider the consistent performance of cultivars across seasons, despite climate variation over time. *Figure 8* indicates the three-year data for the Dendron production area's cultivar trials. The coefficient of variation between the three years is indicated at the top of each cultivar. It appears that Panamera and Sound showed the least variation for the Dendron area.

It is also important to focus on the internal quality of the product so as to ensure economical, optimal, marketable yield and, ultimately, profitability. This includes important factors such as processing characteristics, specific gravity (SG) as well as internal defects (hollow heart and brown spot) as summarised in *Tables 4* and *5*.

Due to technical problems, the Agricultural Research Council (ARC) was unable to provide chip colour results. With regard to SG, the cultivars Belmonda, Connect, Lanorma, Mondial, Sababa and Sound adhered to the norm of ≥1.075 for processing. With regard to internal defects, no cultivar showed signs of hollow heart and brown spot (*Table 5*).

Figure 7: Grading of each cultivar during final harvest.

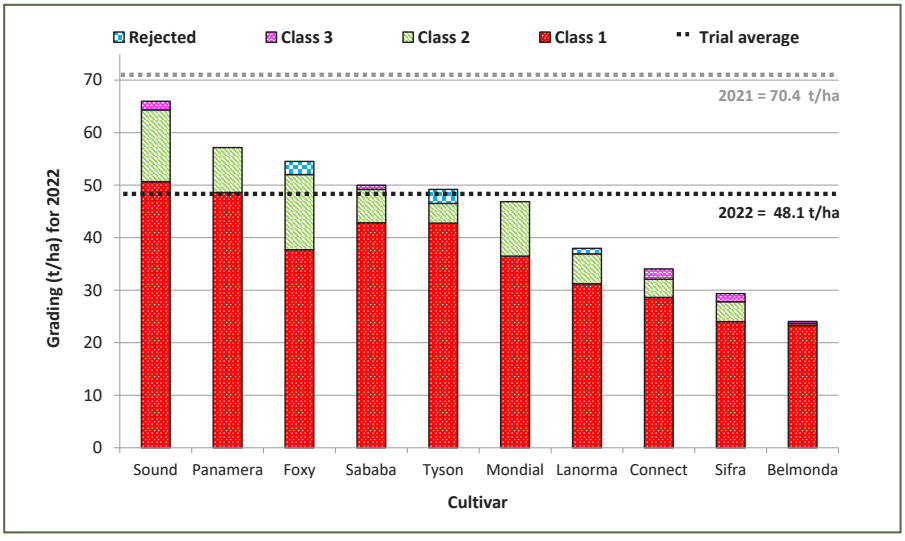


Figure 8: Cultivar performance over three years expressed as a percentage of the trial average.

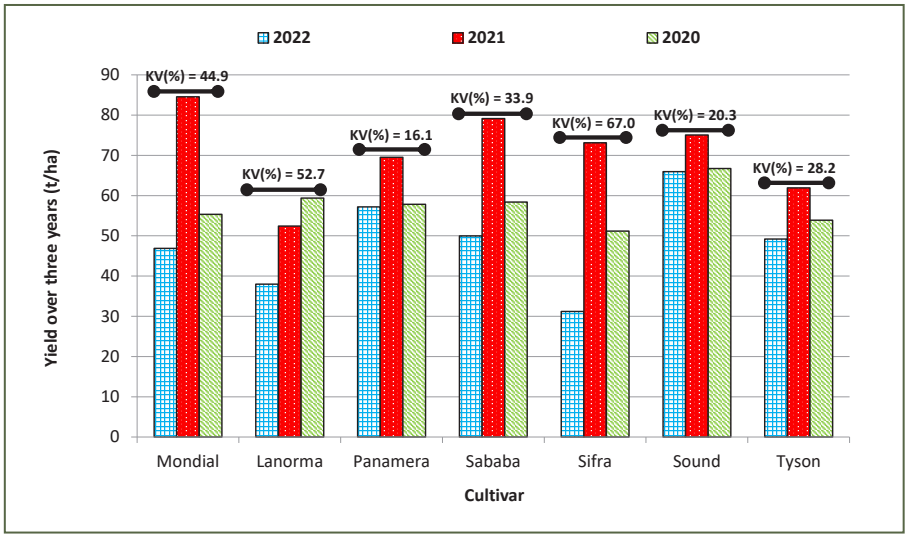


Table 5: Flesh colour and internal quality of the 2022 yield at Dendron.

Thanks to the following co-workers: Mossie Jongbloed, producer, Schalk Grobbelaar, working group chairperson, Jeanine van Jaarsveld, FPD, Chris Prinsloo, Wesgrow, Michelle Lombard, RSA Potato Seed Exchange, and Renier Fourie, GWK. For more information contact Dirk Uys of Potatoes SA at dirk@potatoes.co.za.

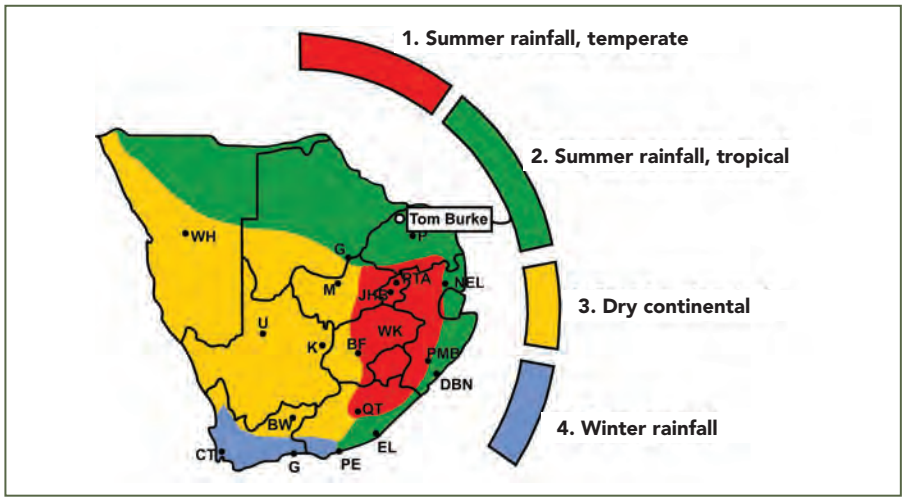
Limpopo cultivar trial under irrigation at Tom Burke in 2022

By Chantel du Raan, Potatoes SA

The Limpopo production region produces approximately 22% (2021 harvest year) of the total potato production, which makes it the highest in South Africa. The region plants potatoes under irrigation for the table and processing markets.

Trials are executed at Tom Burke, which is basically located on Botswana's border. Tom Burke is a tropical summer rainfall area with an annual average rainfall of 371 mm throughout the year (*Figure 1*). Very hot summers occur while winters are cold with black frost occurring in June and July.

Figure 1: Location of Tom Burke in the Limpopo production region.



The trial was carried out in a randomised block design in sandy loam soil with three replications. Additional technical information regarding the trial site and layout is summarised in *Table 1*.

Soil samples were taken prior to planting to determine the soil nutrient status of the trial site. The results of the soil analyses for this trial are contained in *Table 2*.

It is important to note that growth periods can affect the crop yield of cultivars. Growth periods are defined as the number of days from emergence to leaf senescence, depending on the season. The exact timing of the four growth phases depends on

Table 1: Summary of technical information regarding the trial site and layout.

Farm	**Ratho Farm**
Producer	Jako Nel
Planting date	19 May 2022
Harvest date	19 October 2022
Irrigation/dryland	Irrigation
Double or single rows	Double rows
Leaf senescence	Natural
Intra-row spacing	0.75 m
Inter-row spacing	0.30 m
Trial site per unit	15 m^2
Population density	44 444 plants/ha

Table 2: Soil nutrient status of the Tom Burke cultivar trial prior to planting, 2022.

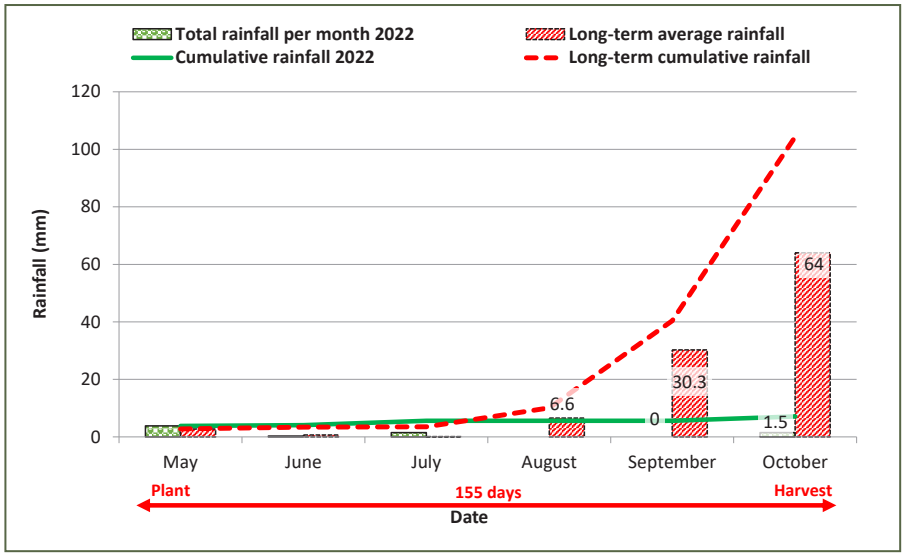
Gross density (kg/m^{-3})	pH (H_2O)	P-Mehlich	Ammonium acetate					% van CUC[1]			
		P	K	Ca	Mg	Na	S	K	Ca	Mg	Na
		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	%	%	%	%
1.49	8.21	62	152	616	218	27	2	7.24	57	33	2.18

[1]*CUC = cation exchange capacity.*

Clay% = 6	Silt (%) = 16	Sand % = 78

	Fertilisation programme					
	Nutrient status					
	N (kg/ha)	P (kg/ha)	K (kg/ha)	Ca (kg/ha)	Mg (kg/ha)	S (kg/ha)
Total	**271.9**	**72.8**	**283**	**1 004.1**	**72**	**336.4**

Figure 2: Rainfall during the 2022 growing season, as well as the long-term average rainfall.



the environment and management practices that vary between localities as well as cultivars due to, among others, different growth periods. The cultivars, plant readiness of tubers, population density (%) and haulm count of this trial are indicated in *Table 3*.

Seasonal influences

Temperature, daylight length and water are the most important abiotic factors influencing the growth patterns, yield and quality of potatoes. To determine the adaptability of new cultivars in the Tom Burke area, it is important to consider these factors when evaluating the performance of different cultivars. It is also important that the cultivars are evaluated across several seasons, since climate differs from one season to the next.

Daily weather data was obtained from the Hanover station on the trial site, whereas the long-term weather data was obtained from the Agricultural Research Council's (ARC) Swartwater station (-22.85186, 28.19898). Small amounts of rainfall were recorded throughout the growing season. In the 2022 growing season a total of 7.11 mm of rain was recorded. This is lower than the long-term average rainfall of 104.3 mm (*Figure 2*).

The minimum as well as maximum temperatures (*Figure 3*) for the 2022 growing season were consistently lower than in previous years. During August to October of the growing season, the maximum temperature fluctuated significantly and was between 35 and 42°C for 34 days and above 30°C for 72 days.

The optimal average air temperature for tuber filling varies between 14 and 22°C. When temperatures rise above 29°C, little or no tuber growth will take place as carbohydrates are then used for respiration. No frost damage was recorded during the growing season.

Effect of heat units

Heat units are also an important factor to consider since the development

of the plant is largely based on the collection of heat units. It is therefore assumed that the plant must collect a certain number of heat units to complete a developmental phase.

The heat units for the 2022 growing season were slightly lower than the long-term average heat units and are indicated in *Figure 4*. At the end of the season, the cumulative heat units of the long-term data were 30.4% lower than the cumulative heat units of this year's season.

Cultivar performance and yield

Yield data collected during harvest was subject to statistical processing using the GenStat® program and the mean was separated using the Tukey test of least significant differences (LSD). The cultivar effect of the 2022 trial (*Figure 5*) was statistically significant ($p<0.05$) in terms of yield, while the coefficient of variation (CV) was low (16%). This indicates that the trials were well executed and that the results are reliable.

The average yield (77.7 t/ha) for the 2022 season was (27.3 t/ha) lower than the trial average of the previous three years (50.4 t/ha). During the 2022 trials (*Figure 5*) the cultivars Foxy, Sound, Valor, Panamera, Mondeo, Sifra and Sababa produced the highest yields and also delivered a higher yield than the trial average (77.7 t/ha).

In order to determine cultivar performance in terms of yield and quality, aspects such as yield,

Figure 3: Minimum and maximum temperatures (°C) during the 2022 growing season as well as the long-term temperature.

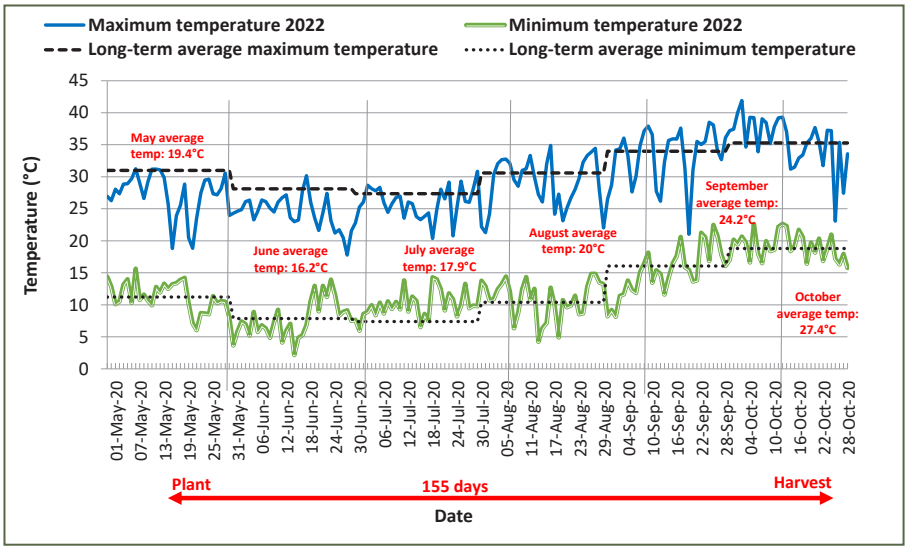
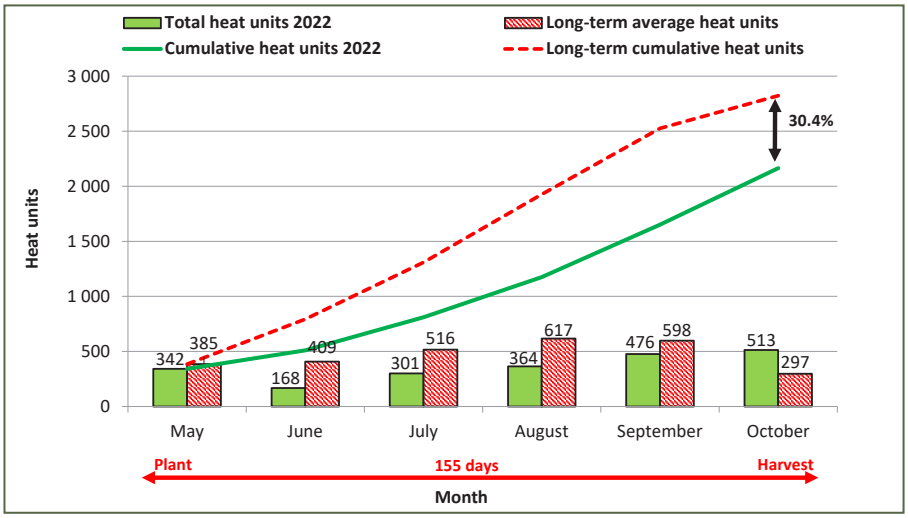


Figure 4: Heat units during the 2022 growing season, as well as the long-term average.



**Total heat units determined for potatoes (threshold temperature = 5°C) as a crop. Calculated from hourly data.*

Table 3: Characteristics relating to growth period, plant readiness, population density (%) and haulm count for each cultivar in the 2022 Tom Burke cultivar trial.

Agent	Cultivar	Growth period (days)[1]		Plant readiness[2]	Population density(%)	Haulms per plant	Haulms per ha
GWK	Connect	Medium to long	(120)	1	100	2.9	128 888
RegenZ	El Mundo	Short to medium	(90-100)	1	100	3.2	142 221
RSA	Foxy	Short to medium	(95-100)	4	100	4.7	208 887
GWK	Lanorma	Short	(80-90)	2	100	4.2	186 665
RegenZ	Mondeo	Medium	(90-110)	1	100	3	133 332
WEgrow	Mondial	Medium to long	(110-115)	4	93.9	3.8	158 585
WEgrow	Panamera	Long	(120-125)	3	100	3.8	168 887
WEgrow	Sababa	Medium to long	(110-115)	3	100	2.6	115 554
WEgrow	Sifra	Short to medium	(90-100)	1	96.9	2	86 132
First Potato Dynamics	Sound	Medium	(100)	4	90.9	4.8	193 918
GWK	Tyson	Short to medium	(90-100)	2	96.9	2	86 132
RSA	Valor	Medium	(100-110)	2	100	3.4	151 110
RegenZ	Vicenta	-	-	1	100	1.4	62 222

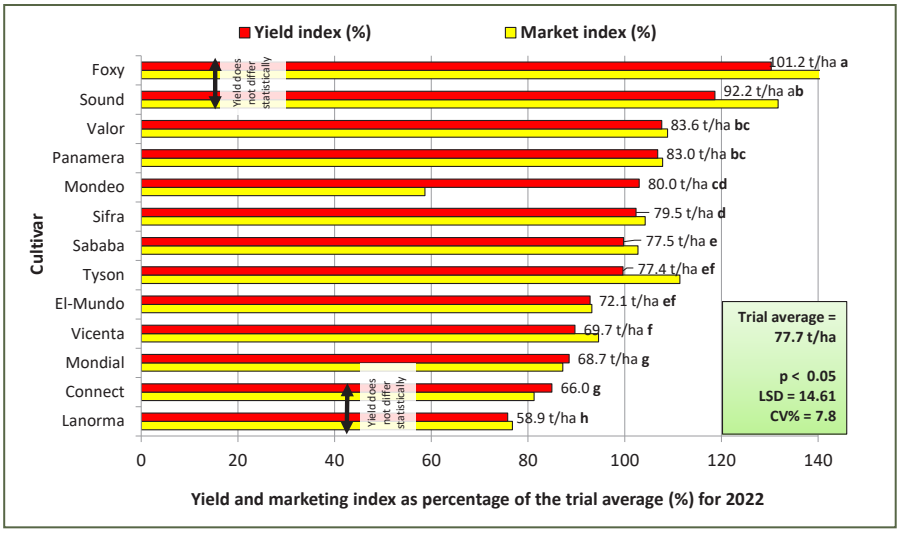
[1]*General guidelines and categories (days from emergence to natural leaf senescence, depending on the season): Short: 70-90 days; Short to medium = 80-100 days; Medium = 90-110 days; Medium to long = 90-120; Long = 90-140 days.*
[2]*Plant readiness of seed potatoes: 1 – Fresh; 2 – Slightly fresh; 3 – Ready for planting; 4 – Slightly old; 5 – Old.*

Table 4: Main reasons for downgrading during the 2022 Tom Burke harvest.

Cultivar	Growth cracks	Regrowth	Insect damage	Mechanical damage	Malformation	Moths	Abraded	Rhizoctonia	Common scab	Sand splitting	Silver scab and black dot	Stem-end rot	Greening	Rot
Connect		●				●	●		●		●			
El Mundo			●			●		●						
Foxy						●				●			●	
Lanorma								●			●			
Mondeo			●			●	●				●			
Mondial					●	●		●		●			●	●
Panamera	●						●				●			
Sababa														●
Sifra						●				●	●	●	●	
Sound						●		●		●	●			
Tyson		●		●										
Valor						●					●	●		
Vicenta						●				●	●			

● *<5% incidence* ● *5 tot 15% incidence* ● *>15% incidence*

Figure 5: Total yield and marketing index per cultivar as a percentage of the trial average.



**Values followed by the same letter do not differ significantly from one another.*

Figure 6: Size-group distribution of each cultivar during final harvest.

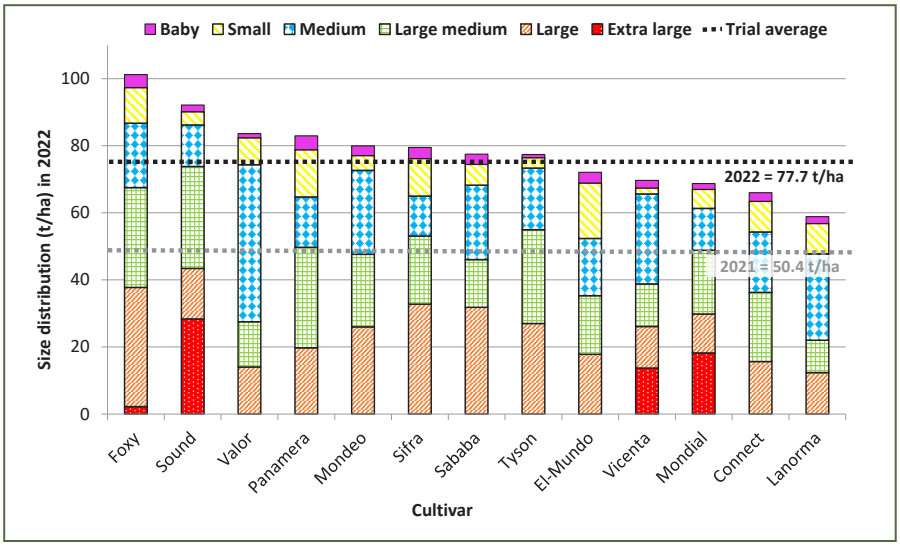
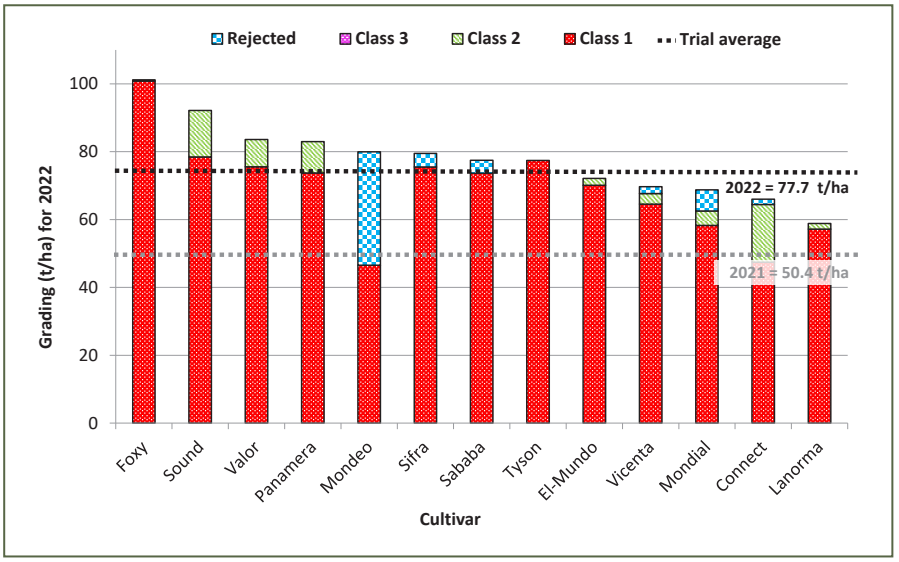


Figure 7: Grading of each cultivar during final harvest.



size-group distribution and class were considered to calculate a marketing index according to the average market prices for the day in question. The yield, multiplied by the prevailing price determined by the tuber size distribution and grading, provides the marketing index (*Figure 5*).

The highest marketing index, which was attained by Foxy and Sound, was the result of a high percentage of Large tuber size distribution (*Figure 6*) and a high percentage of Class 1 grading (*Figure 7*). Tuber size distribution and grading are also used to class potatoes. These factors are therefore crucial in ensuring an optimal, economically marketable yield.

Tuber size distribution is indicated in *Figure 6*, the grading of the yield in *Figure 7*, and the main reasons for the downgrading of the various cultivars are indicated in *Table 4*. High temperatures prior to harvest resulted in many downgrades because of regrowth.

Calculating yield potential

The LINTUL-POTATO-DSS plant growth model was used to calculate the potential potato yield of the control cultivar, Mondial (G4). Potential yield can be defined as the theoretical top yield limit in a situation in which water, nutrients and biological factors are optimal for the season during which the trial was grown. This information makes it possible to compare the actual yield obtained in the trial to simulated potential yields. The difference between the potential and actual yield is the yield gap. It illustrates how efficiently producers use their environment and available resources to achieve high yields.

The ratio between the actual (77.7 t/ha) and potential (85 t/ha) yield for this trial is 97%, revealing a small yield gap which indicates that the available environment was utilised efficiently. This means there are limited opportunities for further yield increases.

It is very important to note the consistency of cultivar performance

Table 5: Processing characteristics and internal quality for 2022. (Conducted by ARC-Roodeplaat).

Cultivar	Chip colour[1]	SG[2]	Dry matter (%)[3]	Hollow heart	Brown spot
Connect	50	1.071	18.38	0	0
El Mundo	48	1.065	17.05	0	0
Foxy	40	1.060	15.92	0	0
Lanorma	57	1.076	19.38	0	0
Mondeo	52	1.064	16.78	0	0
Mondial	57	1.071	18.24	0	0
Panamera	56	1.071	18.38	0	0
Sababa	60	1.066	17.27	0	0
Sifra	55	1.064	16.80	0	0
Sound	59	1.071	18.31	0	0
Tyson	56	1.067	17.44	0	0
Valor	52	1.074	18.96	0	0
Vicenta	54	1.076	19.26	0	0
≥ Norm (acceptable for processing)			<Norm (unacceptable for processing)		

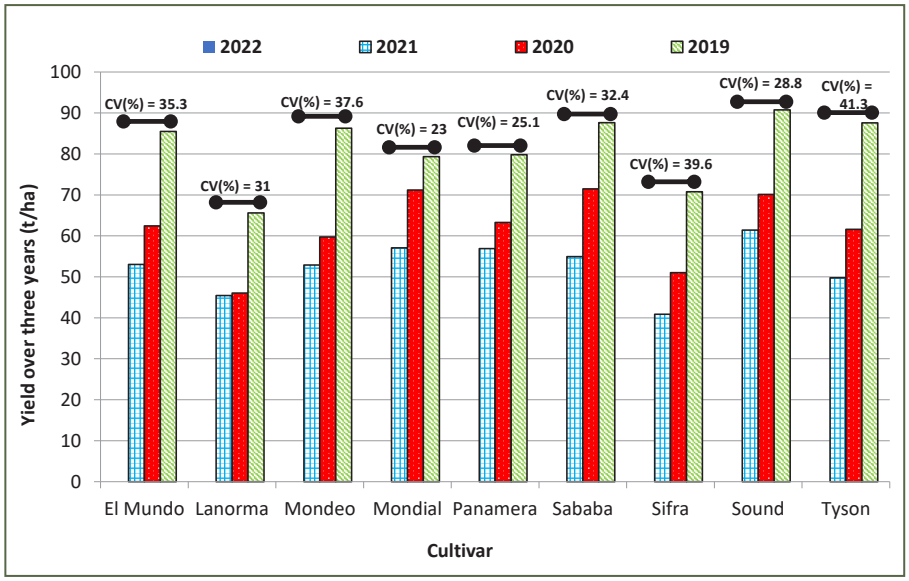
[1]Chip colour with a value of >50 and without defects is acceptable for the chip industry.
[2]Specific gravity of >1.075 is acceptable for the processing industry.
*[3]The percentage dry matter is a calculated value: DM% = 24.182 + 211.04 * (SG-1.0988). The actual percentage value will differ slightly between varieties based on this calculating value.*

despite climate fluctuations over time. *Figure 8* illustrates the three-year data for the cultivar trials in the Tom Burke production area. The coefficient of variation of every cultivar over three years is indicated above each cultivar. It would seem that Lanorma and Sound are showing the least variation for the Tom Burke area.

Furthermore, it is also important to focus on the internal quality of the product to ensure economical, optimally marketable returns and, hence, profitability. This includes important factors such as processing properties, specific gravity (SG) and internal defects (hollow heart and brown spot) which are summarised in *Tables 5* and *6*.

During the 2022 growing season, all the cultivars except El Mundo and Foxy met the norm of >50 for processing. Regarding SG, only Lanorma and Vicenta adhered to the norm of ≥1.075 for processing. No cultivar showed internal defects.

Figure 8: Performance of cultivars measured over three years, indicated as a percentage of the trial average.



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