Processing trial under irrigation at Marble Hall in 2023

By Enrike Verster, Potatoes SA

Marble Hall/Groblersdal is a production region where approximately 3% of South Africa's commercial potatoes (mainly for processing purposes) are produced on roughly 1 702 ha (2023 harvest year). FL2108, Hertha, Markies, and Innovator are the main cultivars produced for processing purposes in the area.

The trial was conducted between Marble Hall and Groblersdal. The area is located in South Africa's summer rainfall area (*Figure 1*) and received an average rainfall of 463 mm over the past 21 years. The region is

Figure 1: Location of Marble Hall in the Limpopo production area.

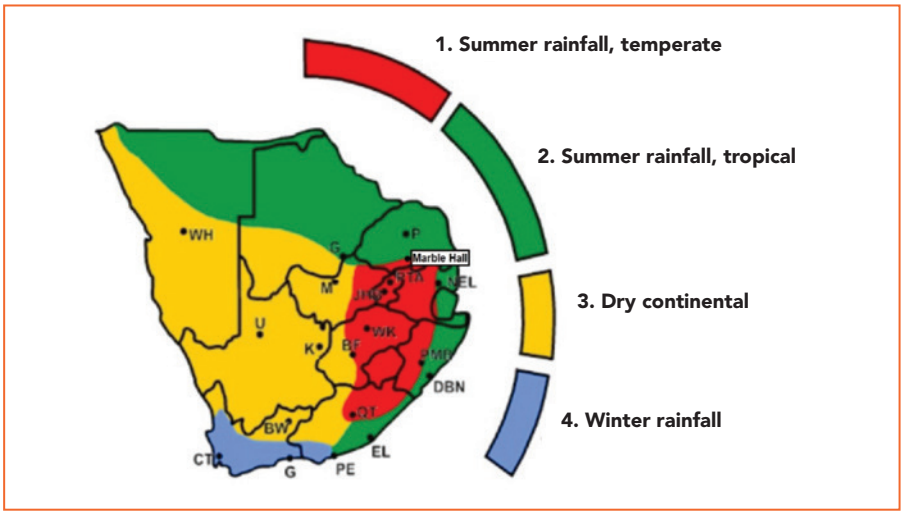


Table 1: Summary of technical information regarding the trial site and design.

Co-worker	**Jaco van den Heever (JFD Boerdery)**			
Planting date	15 June 2023			
	Frost: 25 July 2023			
Harvesting date	25 October 2023			
Irrigation/dryland	Irrigation			
Tuber size	220 count			
Double or single rows	Single rows			
Row width	0.8 m			
Population density	44 000 plants/ha			
Fertiliser programme	**Nutritional value**			
	N (kg/ha)	P (kg/ha)	K (kg/ha)	Ca (kg/ha)
Total	205	75	148	180

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

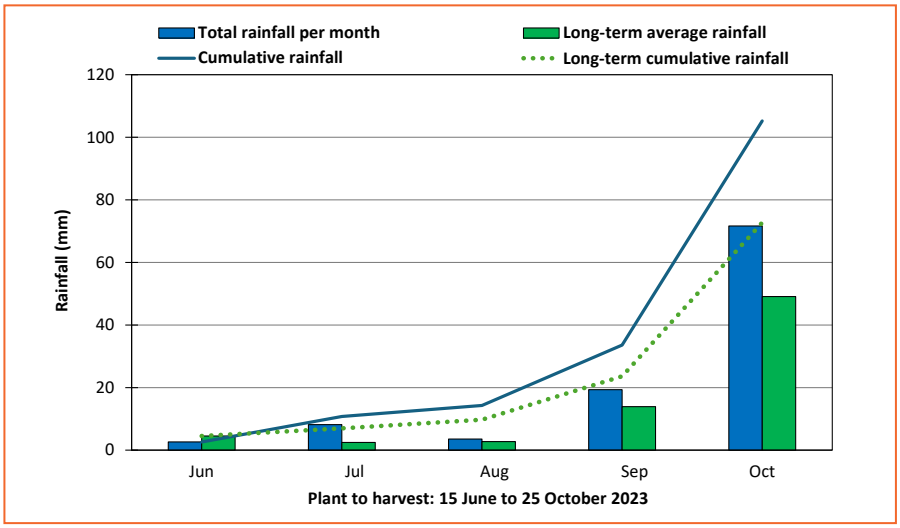
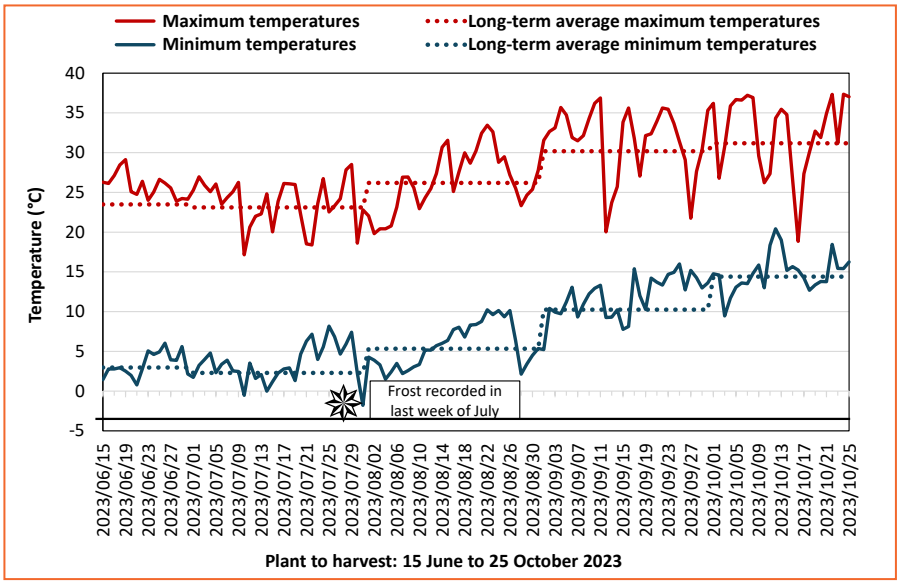


Figure 3: Minimum- and maximum temperatures during the 2023 season as well as long-term average temperatures.



characterised by very warm summers and winters, with the possibility of frost from July to August.

The cultivar trial was conducted in a randomised block design with three replications per cultivar. *Table 1* contains technical information relevant to the trial. Soil analysis results are supplied in *Table 2*.

Growth period and population

Included in the cultivar trial were cultivars with medium to long growth periods. Growing periods can, therefore, influence the eventual yield of certain cultivars. The growth period length is subject to the nature of the season but is regarded as the time that passes from emergence to natural leaf senescence.

Table 3 sets out how growth periods differ from one cultivar to the next. Tuber size and yield are influenced by plant density and the 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-readiness usually leads to improved sprouting and more stems per sprout.

Table 3 indicates the plant readiness of seed potatoes at the time of the trial planting, along with population density percentage and haulm counts recorded later during the growing period.

Marketing indices

Cultivar evaluations such as the Marble Hall cultivar trial provide results regarding both crop yield and marketing indices. The marketing index for the specific cultivars is calculated by classing and sorting each cultivar on a sorting table set for specific size groups in the processing market. Sizes are set out as Large (70+ mm in diameter), Large-medium (70 mm), Medium (55 mm), Small (50 mm) and Extra-small (45 mm). The quality of the potatoes was fairly good and no significant reasons for downgrading were observed or noted.

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

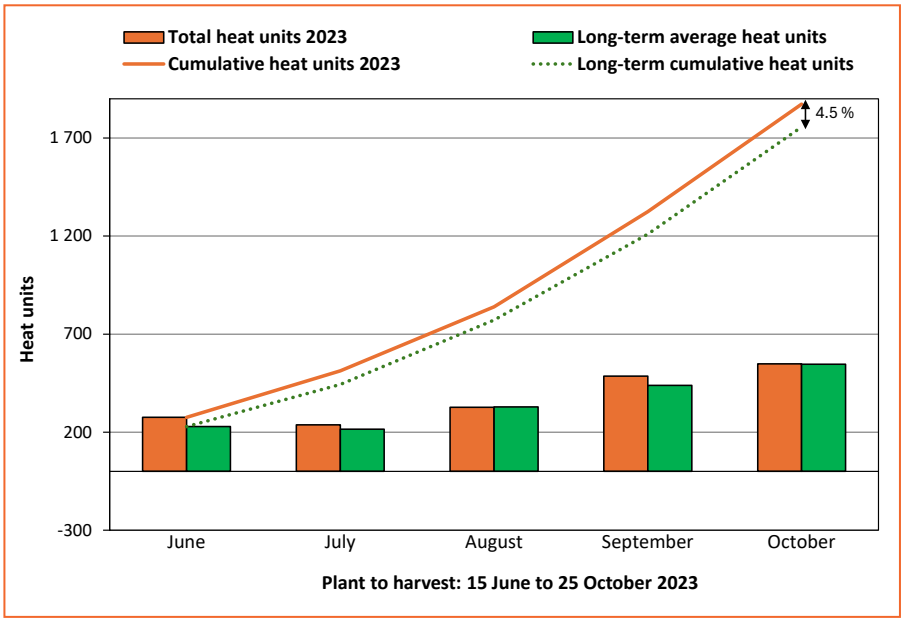
Density ($g.cm^{-3}$)	pH (KCl)	Cations					Base saturation			
		P-Bray 1	K	Ca	Mg	Na	K	Ca	Mg	Na
		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	%	%	%	%
1.14	4.89	97	166	389	93	17	13.27	60.75	23.69	2.29

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 (%)	Haulms per plant	Haulms per ha
Alverstone Russet	Medium	(100)	2	77	2.8	94 864
Cayman	Medium	(100-110)	1	80	5.2	183 040
Markies	Medium to long	(110)	2	94	4.5	186 120
Moonlight	Medium to long	(110-120)	1	83	1.5	54 780
Norman	Medium	(90-100)	1	31	1.3	17 732
P1	Medium to long	(110)	2	94	4.1	169 576
P3	Medium	(95)	3	100	4.2	184 800
Satin King	Medium	(100-110)	2	97	4.1	174 988
Taurus	Medium to long	(110-120)	3	91	5.6	224 224

[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 days; long: 90 to 140 days.
[2]Plant readiness of seed potatoes: 1 = fresh; 2 = slightly fresh; 3 = ready for planting; 4 = slightly old; 5 = old.

Figure 4: Heat units during the 2023 season as well as long-term heat units.



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

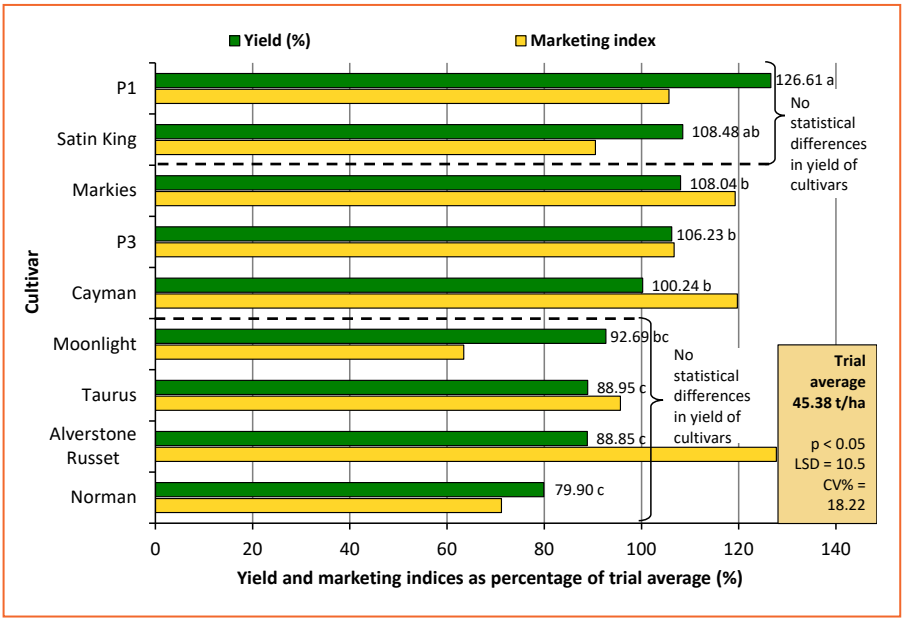
Prices were then compared to market prices obtained during the time of harvest. It is important to note that the performance of new cultivars cannot be based solely on the results of one specific season, as climate conditions vary from year to year. Therefore, cultivars are tested over several seasons.

Significant rainfall

Temperature and water availability (be it rainfall and/or good irrigation scheduling) as well as heat units are important factors that significantly influence the potato plant's growth period. Hence, these factors are carefully considered during the evaluation of cultivar performance.

Relevant daily and long-term weather data was obtained from the nearest Agricultural Research Council's (ARC) weather station.

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.*

During the 2023 season, the rainfall trend was above the norm (*Figure 2*). Scheduled irrigation was effectively managed during the growth period, primarily in winter. This was followed by significantly higher rainfall during October (during the late stages and with leaf senescence).

Figure 3 displays the minimum and maximum temperatures. Several warm days were recorded since August during this trial. A total of 41 days had temperatures above 30°C and 17 days above 35°C. This was recorded from August until harvesting day in October.

Dramatic fluctuations in maximum and minimum temperatures during important growth stages had a negative impact on tuber initiation and development. The producer recorded frost on the trial farm on 25 July. This ultimately influenced the yield.

The collection of heat units during the growth period is an important factor to consider in terms of plant growth. The trend of heat units available for the cultivar trial during this particular season seems to have been above the long-term data trend (*Figure 4*). The area experienced warm temperatures from August to October.

A significant cultivar effect

Yield data collected during harvest was subjected to statistical processing using the GenStat® program. The Tukey test of least significant differences was used to separate the mean.

The cultivar effect during the specific trial (*Figure 5*) was statistically significant ($p<0.05$) in terms of yield, while the coefficient of variation was within limits (18.22%). This indicates that the trial was well executed, and the results are reliable.

The yield of every cultivar is divided by the trial average (the trial average of all the cultivars is taken as 100%). A yield index is created, and every cultivar's performance is read as a percentage of the trial average.

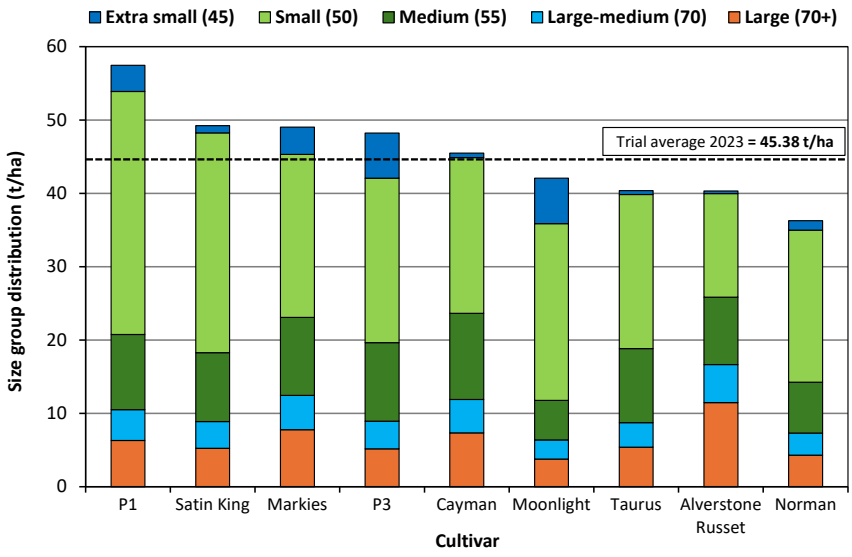
The cultivar trial was conducted in a randomised block design with three replications per cultivar.

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

Cultivar	SG[1]	DM[2]	Chip colour[3]	Flesh colour	Tuber shape	Cooking category[4]
Alverstone Russet	1.087	21.7	58.1	White	Oval	30
Cayman	1.082	20.6	59.8	Cream	Round	40
Markies	1.083	20.9	65.1	Dark yellow	Round	30
Moonlight	1.078	19.7	54.9	White	Round	40
Norman	1.089	22.2	63.1	White	Round	30
P1	1.088	21.9	64.3	Light yellow	Round	40
P3	1.082	20.7	62.7	Dark yellow	Oval	40
Satin King	1.085	21.4	56.7	White	Round	30
Taurus	1.087	21.8	58.1	Cream	Round	20

[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.*
[3]Chip colour with a value of >50 and without defects is acceptable for the chip industry.
[4]Cooking category (taste and texture): 40 = firm potato with a fine texture; 30 = slightly mealy, reasonably firm potato with a mildly fine texture, 20 = mealy, crumbly to loose, 10 = very mealy to loose.

Figure 6: Size-group distribution of each cultivar.



Yield and quality

The average yield for the 2023 season was 45.38 t/ha. P1 and Satin King delivered the highest yields and Alverstone Russet, Cayman, and Markies fetched the highest marketing indices. Size-group distribution is an important factor to consider when evaluating a cultivar's marketability in the processing industry (*Figure 6*). This trial delivered mostly Medium and Small potatoes. Quality, tuber shape, and SG are also important considerations for processors.

Lastly, when considering the internal quality of potatoes, processing qualities can also be evaluated. This is especially important during a processing trial. To comply with processing requirements, cultivars have to comply with a chip colour standard of >50 and an SG of ≥1.075 (*Table 4*). All cultivars complied with the chip colour and SG requirements. The flesh colour and tuber shape were also evaluated. Internal quality was generally good, with a few cultivars exhibiting signs of vascular browning and none indicating brown spot or hollow heart.

Special thanks to the following co-workers: Jaco van den Heever, producer, Danie Marais, Potato Seed Production, Eon Cordier, Wesgrow, Frank Osler, PepsiCo, Jeanine van Jaarsveld, First Potato Dynamics, and Damien da Cal, Dikgetho Mokoena, Laryssa van der Merwe and Billy Pholoso, Potatoes SA.
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