

Effect of fungicide application on potato cultivars at Cedara

James Arathoon, Archana Nunkumar, Taslos Magubane and Morgan Naidoo
(KwaZulu-Natal Department of Agriculture and Rural Development)



The Cedara Research Station (S29° 32' 15 33, E30° 16' 09 19) is situated in the moist mist-belt zone of the KwaZulu-Natal Midlands (900 - 1400 m above sea level), which receives an average annual rainfall of between 838 - 1140 mm (Figure 1). The warm and wet summer conditions are ideal for the appearance of early blight (*Alternaria solani*) and late blight (*Phytophthora infestans* (Mont. de Bary) in potatoes (*Solanum tuberosum* L.). The severity of these diseases, especially late blight, can cause up to 100% crop loss if fungicides are not applied regularly. As a result, seed and table producers will incur large financial

losses, whilst small-holder farmers, who do not always have the resources to purchase fungicides, could become food insecure if their crop fails. A solution for small-holder farmers is to grow cultivars with good tolerance to late blight.

A trial was conducted in the 2018/2019 growing season at the Cedara Research Station to identify cultivars with tolerance to late blight. Eighteen cultivars were evaluated under irrigation in a split-plot trial having a randomized complete block design and three replicates. The cultivar was the main plot, with

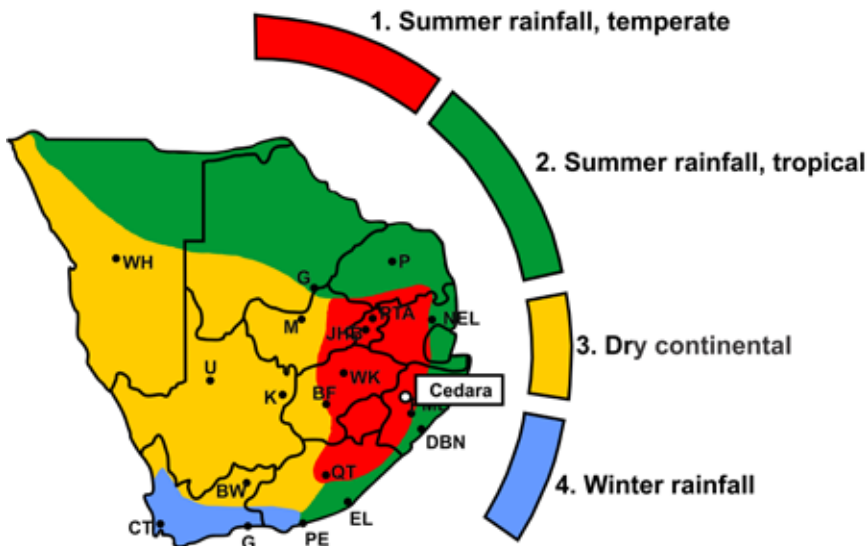


Figure 1: Location of Cedara in the KwaZulu-Natal production region

one half receiving fungicides weekly from ridging, whilst no fungicides were applied to the other half. Five fungicide cocktails (systemic and contact) were applied in rotation. Insecticides were applied to all the plots.

The trial was planted on 19 September 2018 at a seeding rate of 37 037 tubers/ha. Each split-plot consisted of four rows of 5 m length and spaced 0.9 m apart. Data was collected from the two middle rows. Fertilizer was applied according to Fertrec recommendations for a 70 t/ha yield based on the results of a soil analysis. In total, 85 kg/ha P, 316 kg/ha K and 240 kg/ha N were applied. Nine ratings of disease incidence and severity were conducted from 19 October to 19 December. Harvesting occurred from 7 January to 13 February about two to three weeks after die-back of each plot.

Below-average rainfall was received during the growing-season (Table 1). From planting to harvest of the last cultivars, 414.45 mm of rain were received and 288.8 mm of irrigation were applied. The mean monthly maximum temperatures were warmer than average, whilst the mean monthly minimum temperatures were generally cooler.

Most of the seed was considered fresh (no sprouting) or slightly fresh at planting, whilst the seed of Rumba was slightly old (Table 2). As a result, the number of days after planting to 75% emergence ranged from 18 for Georgina to 27 for Lanorma and Electra, whilst the number of days after planting to ridging was 33 for Georgina, 40 for Valor, Mondeo and El Mundo, and 47 for the remaining cultivars. No significant differences in plant population were measured between the cultivars.

Table 1. Monthly rainfall and mean maximum and minimum temperatures received at Cedara during the 2018/2019 season.

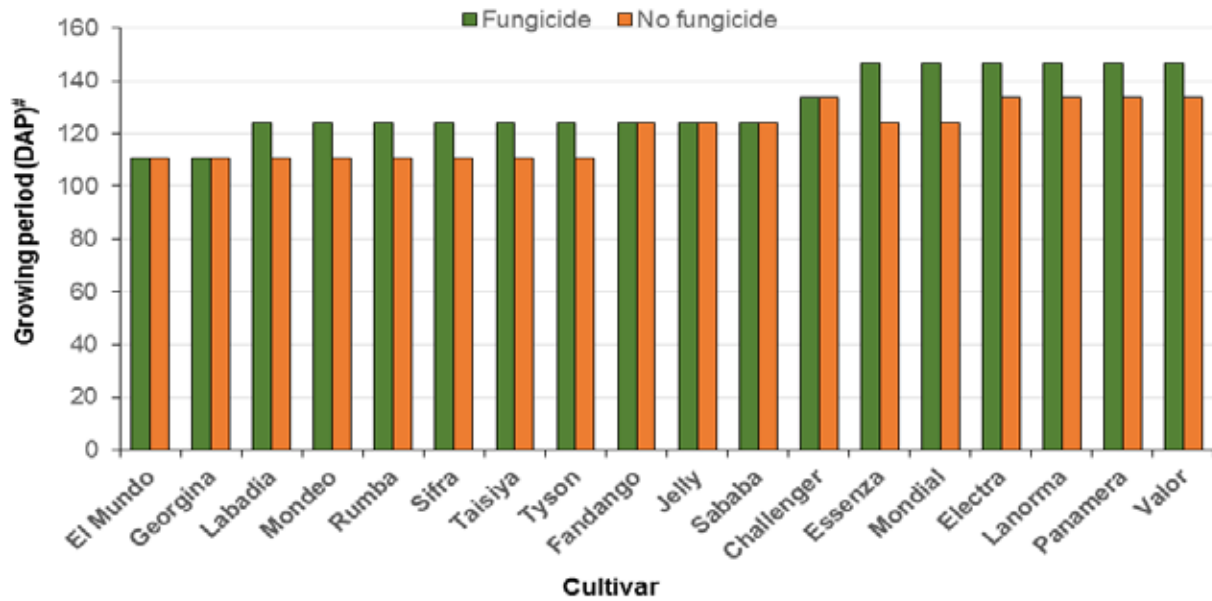
Month	Rainfall 2018/19 (mm)	Long term mean	Maximum temperature (°C)	Long term mean	Maximum temperature (°C)	Long term mean
September	53	50	23.3	22.3	8.1	8.8
October	62	84	23.4	22.5	8.6	10.7
November	41	112	24.3	23.4	10.6	12.5
December	147	127	26.8	24.8	14.9	14.0
January	57	125	25.7	25.2	14.6	15.0
February	123	127	26.0	25.3	14.5	15.0
Total/mean	484	625	24.9	23.9	11.9	12.7

Table 2. Characteristics regarding plant readiness and haulm count for the eighteen cultivars in 2018/2019 growing-season at Cedara.

Kultivar	Groeiperiode (Dae) ¹		Plant-gereedheid ²	Stand (%)	Halms per plant	Halms per hektaar
Challenger	2	6.0	4.9	100	6.3	279 997
Electra	1	4.6	4.2	100	4	177 776
El Mundo	2	8.2	7.1	100	5.5	244 442
Essenza	2	3.1	2.8	100	6.1	271 108
Fandango	1	2.7	3.0	100	5.8	257 775
Georgina	3	5.9	6.4	100	4.2	186 665
Jelly	3	3.1	2.7	100	3.8	168 887
Labadia	2	2.8	2.9	100	4.5	199 998
Lanorma	2	3.6	3.4	100	2.8	124 443
Mondeo	2	7.3	6.1	100	4.2	186 665
Mondial	1	2.7	3.0	100	4.2	186 665
Panamera	1	2.7	2.5	100	4.6	204 442
Rumba	4	3.2	3.2	100	4	177 776
Sababa	1	2.5	2.5	100	4.9	217 776
Sifra	1	3.8	3.4	100	5.5	244 442
Taisiya	2	4.9	4.4	100	6.1	271 108
Tyson	1	2.7	2.7	100	5.8	257 775
Valor	3	3.9	4.0	100	4.2	186 665
Mean	2	4.1	3.9	100	3.8	168 887

¹ Plant readiness of seed tubers: 1 = Fresh; 2 = Slightly fresh; 3 = Plant ready; 4 = Slightly old; 5 = Old





Growing period is the number of days from planting to harvest (DAP)

Figure 2. Characteristics regarding the growing period for the eighteen cultivars in the 2018/2019 growing-season at Cedara.

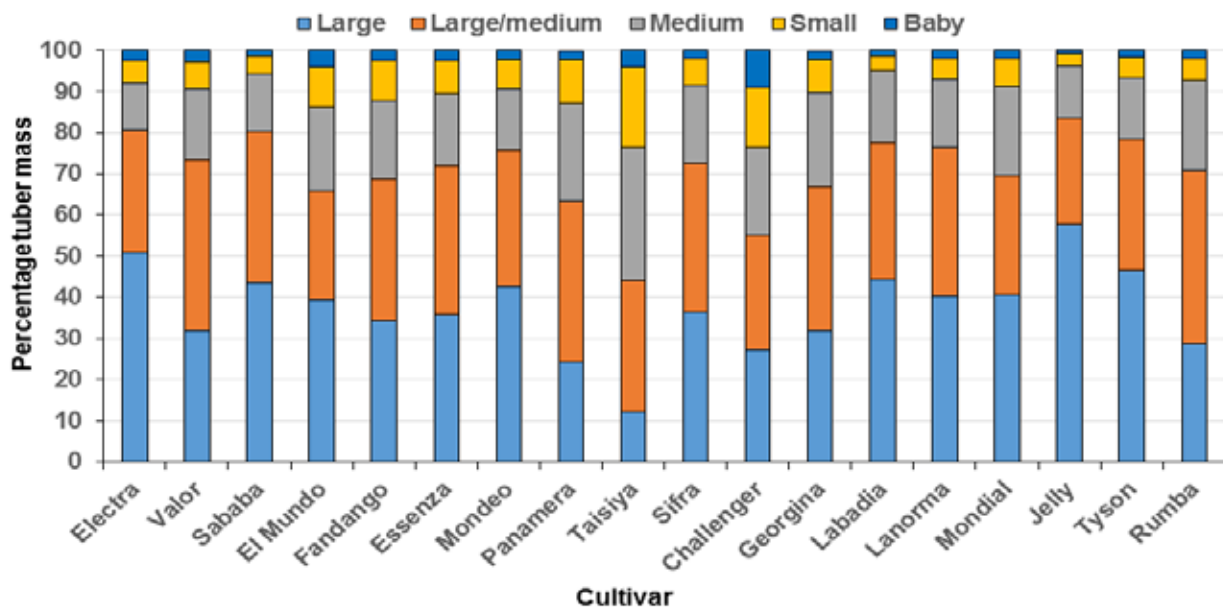


Figure 3. Percentage tuber mass of total yield at the five size grades for the eighteen cultivars sprayed with fungicides.

The number of haulms/plant ranged from an average of 2.5 for Sababa to 7.6 for El Mundo (Table 2). Overall, significantly more haulms/plant were produced when fungicides were applied. Despite these variations, the number of haulms/plant was not significantly correlated to yield.

Rumba, Challenger, Taisiya and Lanorma had medium growth vigour, whilst the rest had strong growth

vigour. All the cultivars reached 100% canopy cover, but the number of days after planting to reach 100% ranged from 61 to 78.

The first signs of late blight were in early November. Although disease ratings were not conducted over the whole season, all the cultivars had plants infected with late blight, irrespective of the fungicide treatment. The percentage infected plants ranged from 43.1%

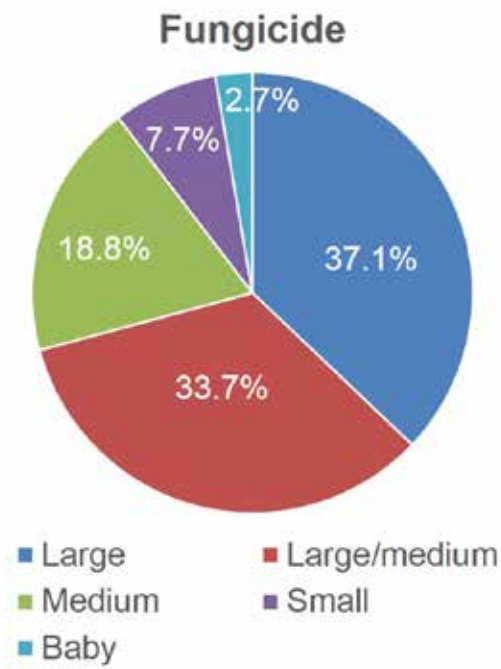


Figure 4. Percentage of the five tuber sizes for the eighteen cultivars with fungicides applied.

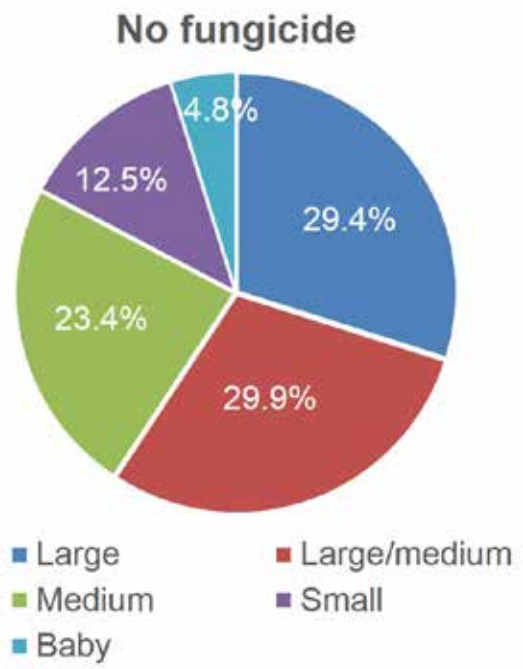


Figure 5. Percentage of the five tuber sizes for the eighteen cultivars without fungicides applied.



Table 3. Pre-harvest allocated variable costs for the two fungicide treatments.

Allocated variable costs	Fungicide (R/ha)	No fungicide
Directly allocated costs		
Irrigation (288.8 mm x R4.57/mm)	1 319.82	1 319.82
Seed (150 x 25 kg bags x R200/bag)	32 000.00	32 000.00
Fertilizer (as per trial)	12 507.01	12 507.01
Agro-chemicals (as per trial)	13 577.62	5 734.02
Indirectly allocated costs		
Casual labour (40.5 hrs x R20/hr)	810.00	810.00
Fuel (150 L x R14.90/L)	2 235.00	2 235.00
Repairs and maintenance	2 000.00	2 000.00
Total pre-harvest allocated variable costs	64 449.45	56 505.85

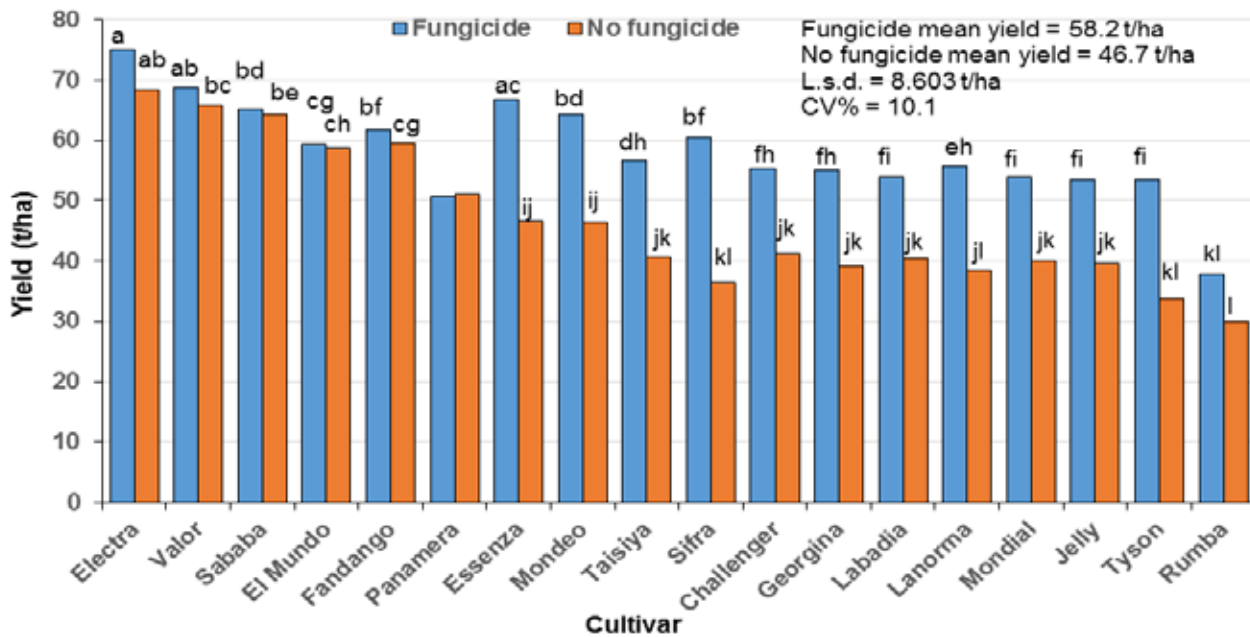


Figure 6. Yield of the eighteen cultivars for the two fungicide treatments.

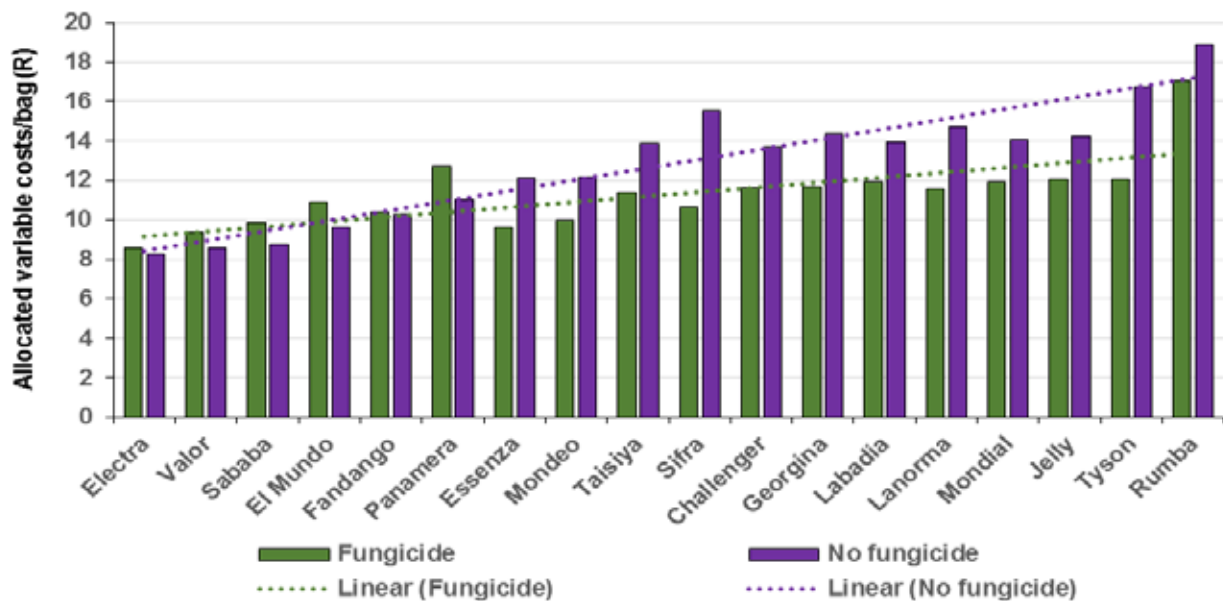


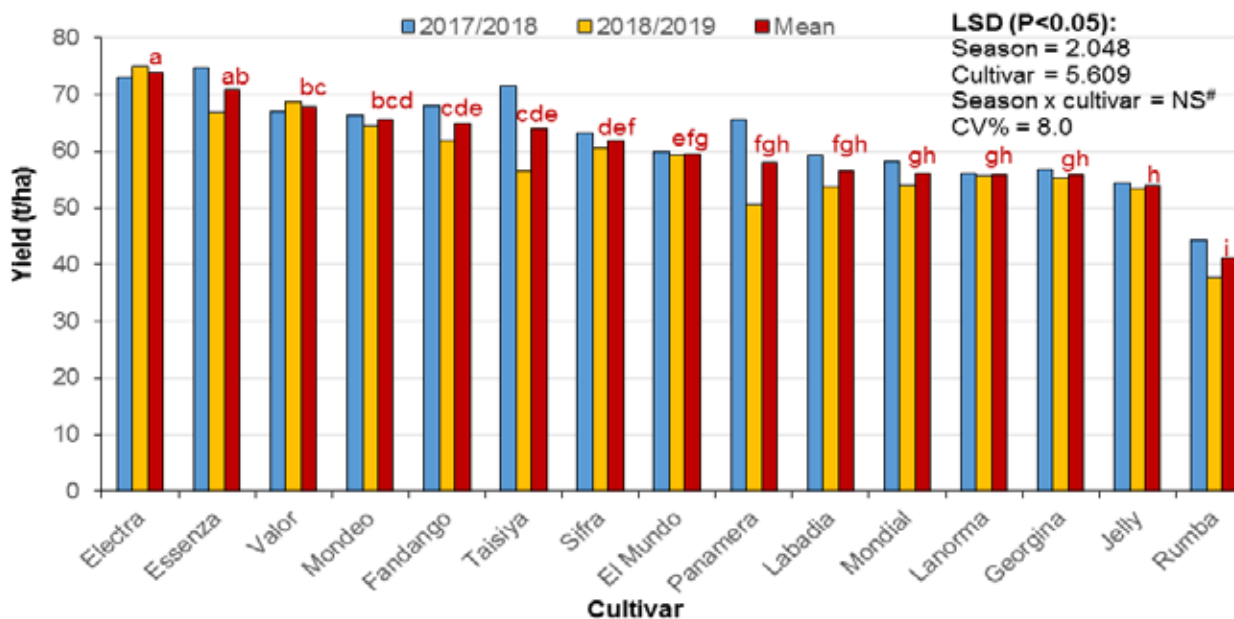
Figure 7. Allocated variable pre-harvest costs per 10 kg bag for the eighteen cultivars and two fungicide treatments.

for Lanorma (fungicides applied) to 100% for Rumba, Georgina, Taisiya, Mondeo and Tyson (no fungicides applied). With fungicides, 72% of the plants were infected, whilst 82% were infected when no fungicides were applied. However, no significant interaction was measured for disease incidence between the cultivars and fungicide treatments.

Disease severity ratings were done according to the percentage of leaves infected. These ranged from 0 (no visible signs) to 5 (whole plant blighted and

dead). No significant interaction was measured for percentage disease severity between the cultivars and fungicide treatments. A full season of disease ratings may have provided a different result, because, visually, Electra, Valor, Sababa, El Mundo, Fandango and Panamera showed good tolerance to late blight.

El Mundo and Georgina were the first cultivars to be harvested, 111 days after planting, indicating that they are short-season cultivars (Figure 2). Despite Electra, Panamera and Valor being tolerant to late blight,



#NS = Not significant

Figure 8. Yield of the fifteen cultivars evaluated with fungicide applications during the 2017/2018 and 2018/2019 seasons at Cedara.

these cultivars stayed green for longer when sprayed with fungicides and therefore they were harvested later.

Jelly and Electra had the highest percentages of large tubers (Figure 3). Taisiya had the lowest percentage of large tubers, but the highest percentages of medium, small and baby tubers. With fungicides, significantly higher percentages of large and large-medium tubers were produced (Figure 4) compared to no fungicide applications (Figure 5). Without fungicides, Tyson, Georgina and Sifra had > 20% decreases in large tuber mass.

The good visual tolerance to late blight that was observed with Electra, Valor, Sababa, El Mundo, Fandango and Panamera was confirmed by no significant differences in yield being measured between the two fungicide treatments for each of these six cultivars (Figure 6). The remaining twelve cultivars all produced significantly lower yields when no fungicides were applied. Electra, Valor and Essenza produced the highest yields with fungicides applied.

An exercise was conducted to determine the financial implications of applying the two fungicide treatments and to determine the pre-harvest cost per 10 kg bag based on the yields obtained by the cultivars. Table 3 lists the pre-harvest directly allocated variable costs according to the inputs applied to the trial and the indirectly allocated variable costs based on the

KwaZulu-Natal Department of Agriculture and Rural Development's 2018/19 Field Crop Budgets for potatoes.

As a result of the six late blight tolerant cultivars each producing non-significantly different yields between the two fungicide treatments, these cultivars had lower pre-harvest allocated variable costs per 10 kg bag when no fungicides were applied (Figure 7). Therefore, the susceptible cultivars had lower input costs/bag when fungicides were applied due to the resulting higher yields.

Fifteen cultivars were evaluated with fungicide applications in both the 2017/2018 and 2018/2019 seasons. A statistical analysis indicated that there were no significant yield responses by the cultivars when comparing the two seasons, overall (Figure 8). However, Taisiya and Panamera produced considerably lower yields in the 2018/2019 season. This contributed to a significantly lower mean yield for the 2018/2019 season. Mondial, Valor and Sifra are grown on a large scale in KwaZulu-Natal. However, Mondial and Sifra did not yield as well as some of the other cultivars.

As most of the high yielding cultivars are tolerant to late blight, these cultivars show promise for growing in the KwaZulu-Natal Midlands. They are especially suitable for rural small-holders, who cannot afford to purchase fungicides to control late blight. ©