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**OOS-VRYSTAATSE STANDPROEF
ONDER AANVULLENDE
BESPROEIING IN REITZ**

**THE POTATO LEAF MINER:
ORIGIN OF THE FIRST FLY
INFESTATIONS OF THE SEASON**

Tegnologiese ontwikkeling: | Effect of fungicide application | Engagement with New Era
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The effect of fungicide application on potato cultivars at Cedara

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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 to 1 400 m above sea level), which receives an average annual rainfall of between 800 to 1 140 mm.

The warm and wet summer conditions are ideal for the appearance of early blight (*Alternaria solani* Sorauer) and late blight (*Phytophthora infestans* [Mont.] de Bary) in potatoes (*Solanum tuberosum* L.). The severity of these diseases, especially late blight, can cause crop losses of up to 100% if fungicides are not applied regularly. As a result, seed and table producers will incur large financial losses, while household growers, who do not always have the resources to purchase fungicides, could become food insecure if their crops fail. A solution for household growers is to grow cultivars with good tolerance to late blight.

Testing tolerance to blight

A trial was conducted in the 2020/2021 growing season at

the Cedara Research Station to identify cultivars with tolerance to late blight. Seventeen cultivars were evaluated under irrigation using a split-plot design with three replicates. The cultivar was the main plot, which was split for fungicide application and no fungicide application.

The trial was planted on 16 September 2020 at a seeding rate of 37 037 tubers/ha. Fertiliser

was applied according to Fertrec recommendations for a 70 t/ha yield based on the results of a soil analysis. In total, 120 kg/ha P, 120 kg/ha K and 240 kg/ha N were applied.

Each split-plot consisted of four rows of 5 m in length, and rows were spaced 0.9 m apart. Six fungicides (systemic and contact) were applied weekly in a rotation commencing immediately after

Figure 1: The percentage disease incidence of late blight on seven sprayed cultivars over time.

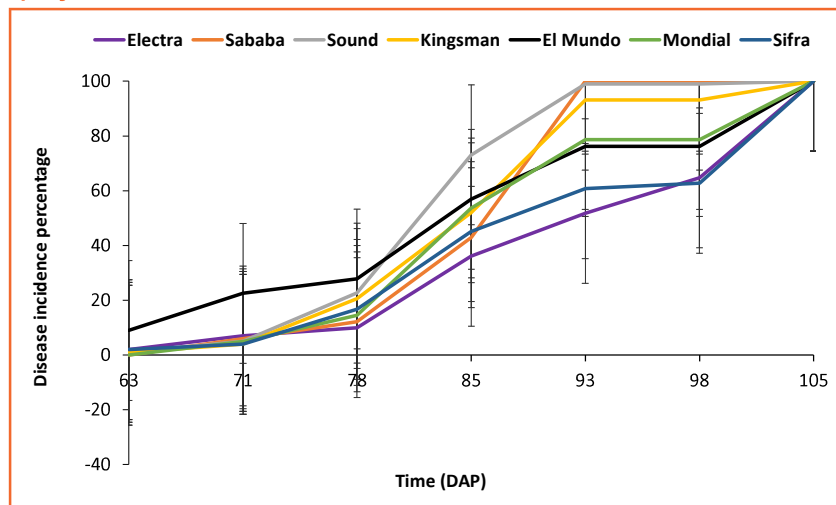


Table 1: Monthly rainfall and mean monthly maximum and minimum temperatures at Cedara during the 2020/2021 growing season.

Month	Rainfall		Maximum temperature		Minimum temperature	
	2020/ 2021	Long-term mean	2020/ 2021	Long-term mean	2020/ 2021	Long-term mean
	(mm)		(°C)			
September	13	50	22.7	22.3	8.4	8.8
October	63	84	24.3	22.5	11.6	10.7
November	188	112	24.7	23.4	13.3	12.5
December	111	127	27.5	24.8	16.3	14
January	123	125	27.6	25.2	16.7	15
February	85	127	26.6	25.3	16.2	15
Total/mean	583	625	25.6	23.9	13.8	12.7

Table 2: Seed quality rating, number of days after planting (DAP) to 75% emergence, plant density, haulms/plant and growth vigour of the 17 cultivars.

Cultivar	Plant readiness*	75% emergence (DAP)	Plant density (number/ha)	Haulms/plant (number)	Growth vigour
Allison	3	19	36 674 ab [#]	5.700 de	5
Alverstone Russet	3	20	37 037 a	4.950 eg	5
El Mundo	2	22	36 855 ab	9.717 a	5
Electra	2	26	36 855 ab	8.525 b	5
Kingsman	3.5	19	37 037 a	3.667 ij	5
Labadia	2	22	37 037 a	4.567 fh	5
Lanorma	2.5	27	34 495 c	3.500 ik	4
Mondeo	2	22	35 948 ab	6.633 c	5
Mondial	3	21	36 129 ab	5.117 df	5
Morgana	3	19	37 037 a	5.783 d	3
Panamera	2.5	24	36 674 ab	2.300 l	5
Sababa	3	21	36 129 ab	4.500 fh	5
Sifra	3	21	37 037 a	3.000 jl	4
Sound	3.5	20	36 492 ab	4.917 eg	5
Taisiya	3	22	35 585 bc	4.200 gi	3
Tyson	3	21	37 037 a	2.800 kl	5
Valor	2	24	36 855 ab	3.817 hi	5
Mean	2.7	22	36 524	4.923	4.6

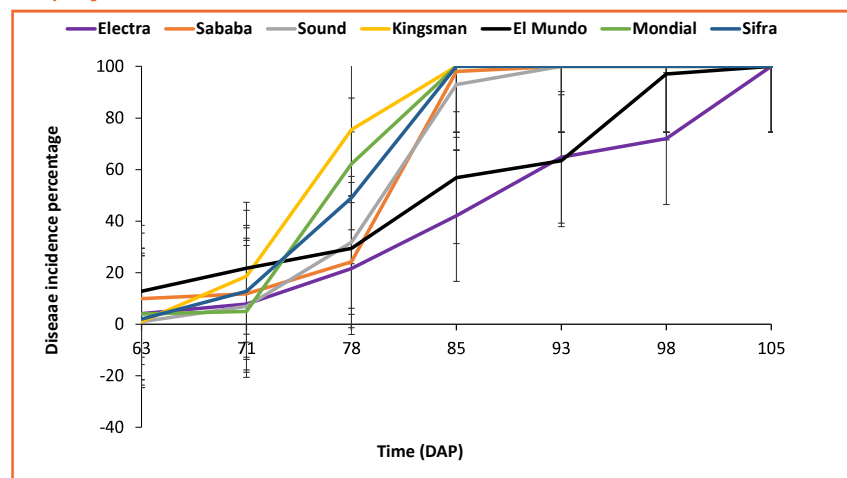
*Plant readiness of seed tubers: 1 = fresh, 2 = slightly fresh, 3 = slightly ready, 4 = slightly old, 5 = old.

ridging on 26 October 2020 until 26 January 2021. Insecticides were applied weekly to the whole trial.

Data was collected from the two middle rows. Twelve ratings of blight disease incidence and severity were conducted between 18 November and 3 February 2021. Harvesting occurred from 5 January to 3 February, approximately two to three weeks after dieback of each plot.

Below-average rainfall was received during the growing season (Table 1). From planting to harvest of the last cultivars, 497.3 mm of rain was received, and 201 mm of irrigation was applied. The mean

Figure 2: The percentage disease incidence of late blight on seven unsprayed cultivars over time.



monthly maximum and minimum temperatures were warmer than average.

Assessing the cultivar quality

Variations in seed quality of the cultivars at planting did not appear to influence the time to 75% emergence, which ranged between 19 and 27 days (Table 2). However, at planting some of the Lanorma tubers were slightly withered. This may account for Lanorma taking the longest time to reach 75% emergence, and for the significantly lower plant population.

The plant density of Taisiya was significantly lower than that of some cultivars. The mean number of haulms per plant ranged from 2.30 for Panamera, to 9.72 for El Mundo (Table 2), but was not significantly correlated to plant population or yield.

Growth vigour is an indication of how well the crop grew and canopied. Morgana, Taisiya, Lanorma and Sifra did not reach 100% canopy cover (Table 2).

The abundant rainfall in November, together with the warm conditions, resulted in a quicker development and spread of late blight compared to the two previous growing seasons. Early blight occurred at the same time as late blight, whereas in the two previous growing seasons, early blight only infected the crop towards the end of December. Early and late blight had infected all the plots by 71 DAP.

Figures 1 and 2 show the effect of the fungicide treatments on the incidence of late blight for the five highest-yielding cultivars and the two industry standard cultivars, Mondial and Sifra, which are known to be susceptible and very susceptible to late blight, respectively.

With fungicides applied, Sababa reached 100% disease incidence at 93 DAP, whereas, without fungicides, Sababa, Kingsman, Mondial and Sifra had 100% disease incidence at 85 DAP. At 105 DAP, all cultivars had 100% disease incidence. The cultivars Electra and El Mundo had lower

Figure 3: The percentage disease incidence of early blight on seven sprayed cultivars over time.

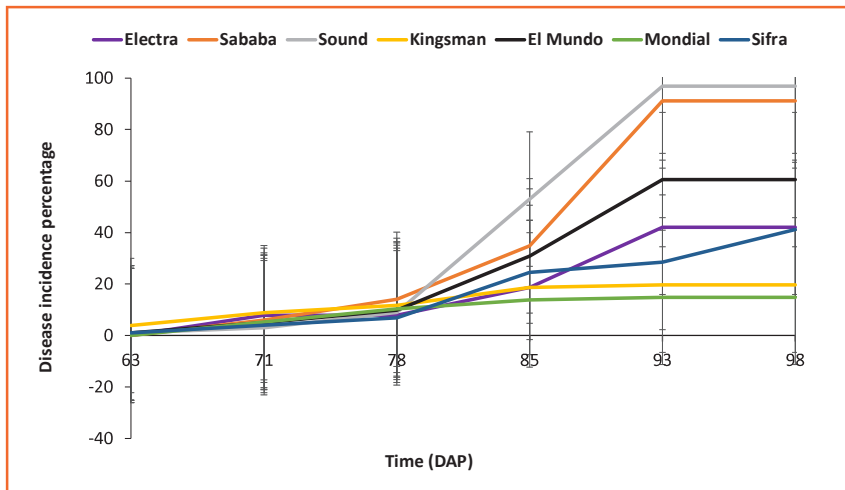


Figure 4: The percentage disease incidence of early blight on seven unsprayed cultivars over time.

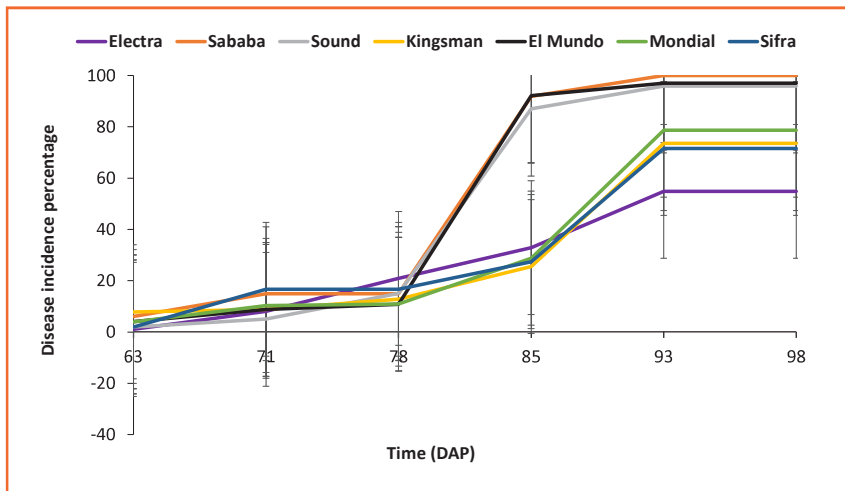


Figure 5: Disease severity percentage over time on earlier maturing cultivars sprayed with fungicides.

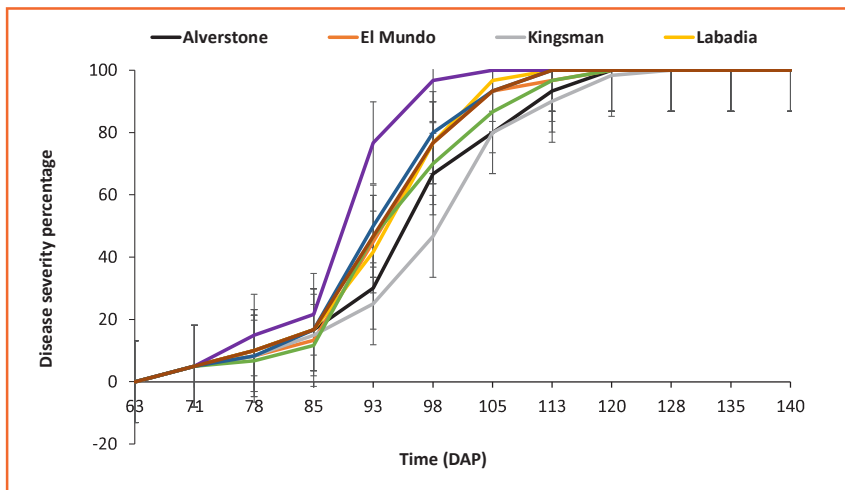


Figure 6: Disease severity percentage over time on unsprayed earlier maturing cultivars.

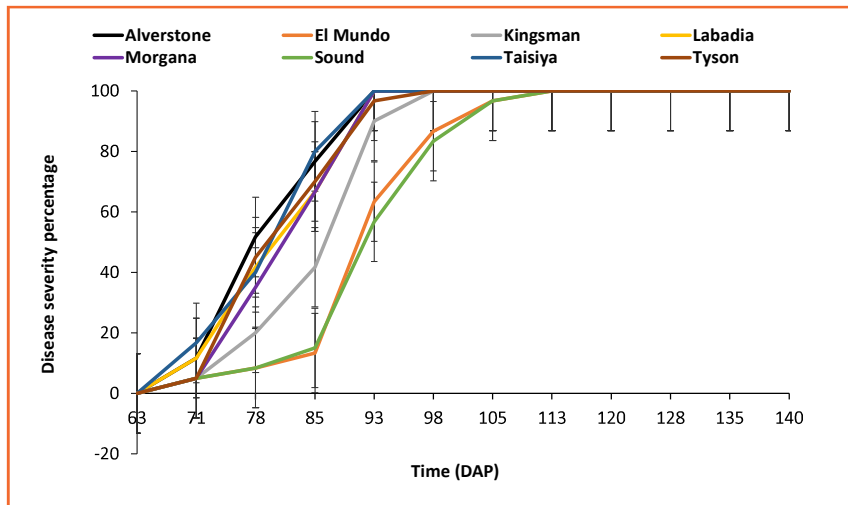


Figure 7: Disease severity percentage over time on later maturing cultivars sprayed with fungicides.

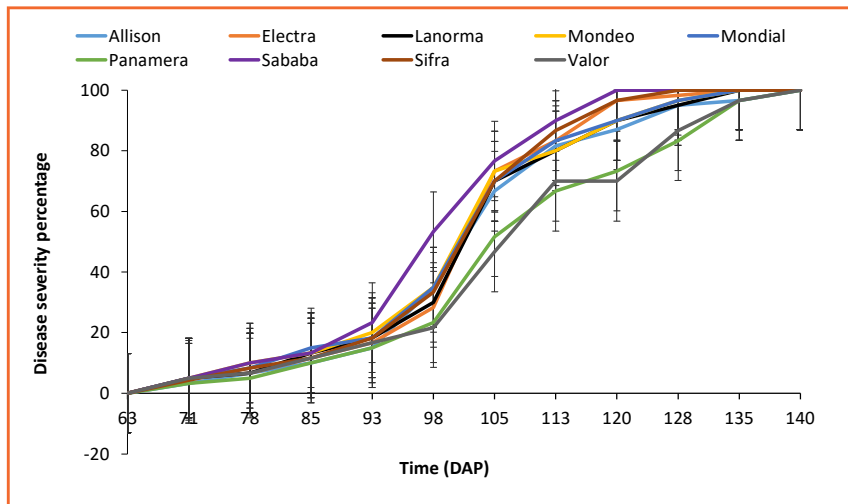
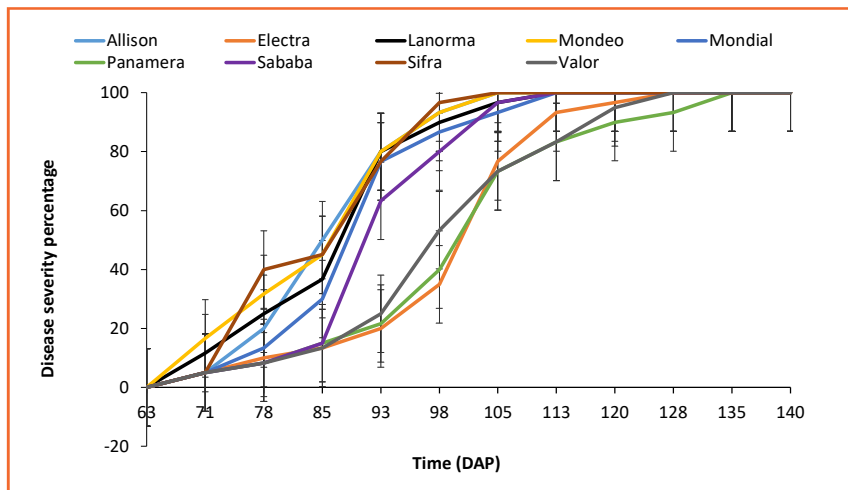


Figure 8: Disease severity percentage over time on unsprayed later maturing cultivars.



disease incidences in both treatments, indicating a level of tolerance to late blight.

As expected, early blight incidence was lower in the sprayed treatment compared to the unsprayed treatment (Figures 3 and 4). No cultivars within the top-five yield rankings had 100% early blight incidence in the sprayed treatment. In the unsprayed treatment, the cultivars Sababa, Sound and El Mundo showed a rapid increase in disease incidence after 78 days from planting.

Sound also showed a rapid increase after 78 days from planting when fungicides were applied. Sababa had 100% early blight incidence in the unsprayed treatment. Disease incidence for early blight was recorded until 98 DAP. This was due to a rapid increase in late blight infection, which, being more aggressive, completely dominated over early blight.

Severity of diseases

Disease severity is the percentage of plants covered by symptoms of the pathogen. It indicates the extent of damage caused by the disease. For disease severity, cultivars were grouped into two maturity groups (i.e., earlier and later maturing cultivars). The results showed a significant interaction between the different cultivars and spray treatments applied.

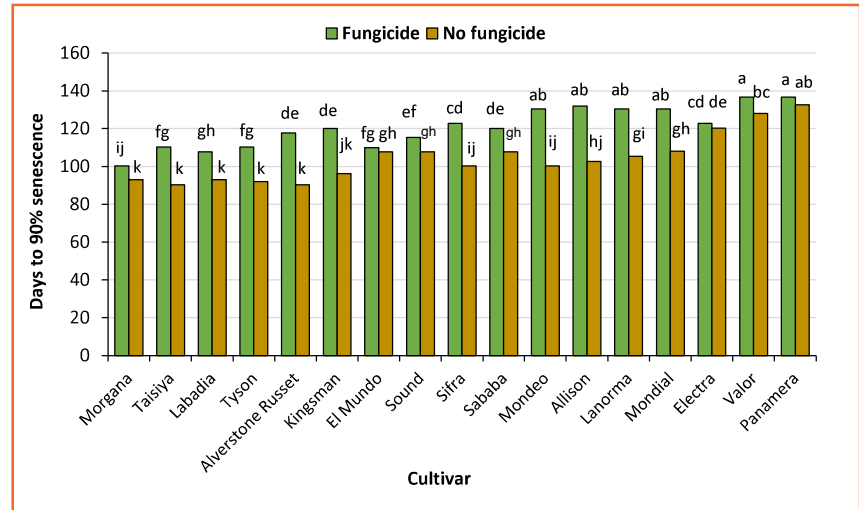
With fungicides, the cultivars had significantly lower disease severity percentages compared to when no fungicides were applied in both maturity groups. In the earlier maturing group, fungicides tended to suppress disease severity by 14 days for most of the cultivars (Figures 5 and 6).

All the earlier maturing cultivars had reached 100% disease severity at 128 DAP. In the later maturing group, all the cultivars had reached 100% disease severity at 140 DAP (Figures 7 and 8). Although the cultivars in this group responded differently, fungicides tended to suppress the rapid increase in severity by three weeks.

Without fungicides, Sound and El Mundo in the earlier maturing group (Figure 5), and Electra, Panamera and Valor in the later maturing group (Figure 8), had lower disease severities than the other cultivars, indicating a level of tolerance to the late blight. Since late blight is a rapidly progressive disease, it is imperative to use fungicides as it lowers the rate of disease progression and allows for higher yields to be obtained.

Variations in disease severity are mainly due to climatic factors and pathogen virulence. The increase in disease severity could be due to a change in the pathogen population. The reason that

Figure 9: The number of days from planting to 90% senescence for the 17 cultivars with the two fungicide treatments.



A trial was conducted in the 2020/2021 growing season at the Cedara Research Station to identify cultivars with tolerance to late blight. Seventeen cultivars were evaluated under irrigation using a split-plot design with three replicates.

Figure 10: Percentage mass of the five tuber sizes for the 17 cultivars with fungicides.

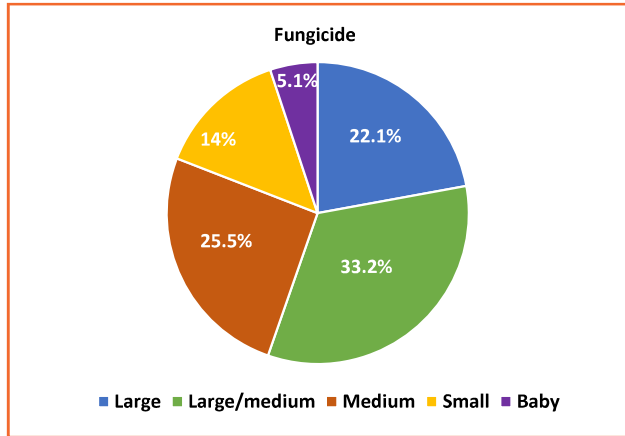
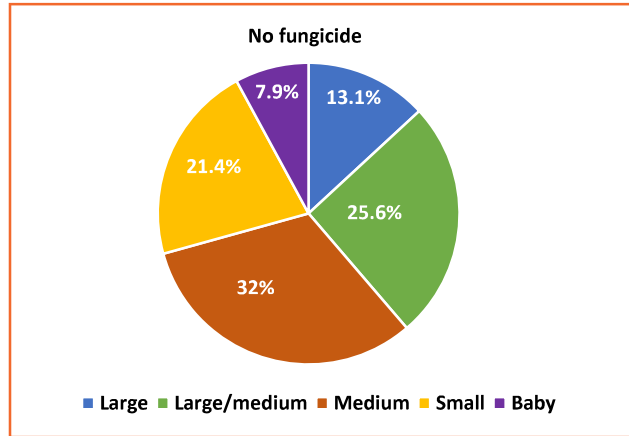


Figure 11: Percentage mass of the five tuber sizes for the 17 cultivars without fungicides.



cultivars lose their tolerance to late blight is because the resistance level of the cultivars is being defeated due to the matching of new virulence genes in the pathogen.

The number of days to 90% senescence gives an indication of the length of the growing season of the various cultivars with the fungicide treatments (Figure 9). Overall, the application of fungicides extended the number of days to 90% senescence by 15. Cultivars that were more susceptible to late and early blight defoliated and died quicker, especially when no fungicides were applied.

Morgana had the shortest growing season (97 days), while

Valor (132 days) and Panamera (135 days) had the longest growing seasons overall. When comparing cultivars individually, no significant differences were measured between the fungicide treatments for El Mundo, Electra and Panamera, indicating good tolerance to late blight.

Longer growing time, greater yield

A significant positive correlation was measured between the number of days to 90% dieback and yield, indicating that the longer the growing season, the greater the yield. Overall, the early defoliation of plants due to blight resulted in significantly lower percentages of large- and large/

medium-sized tuber masses and consequently, lower yields.

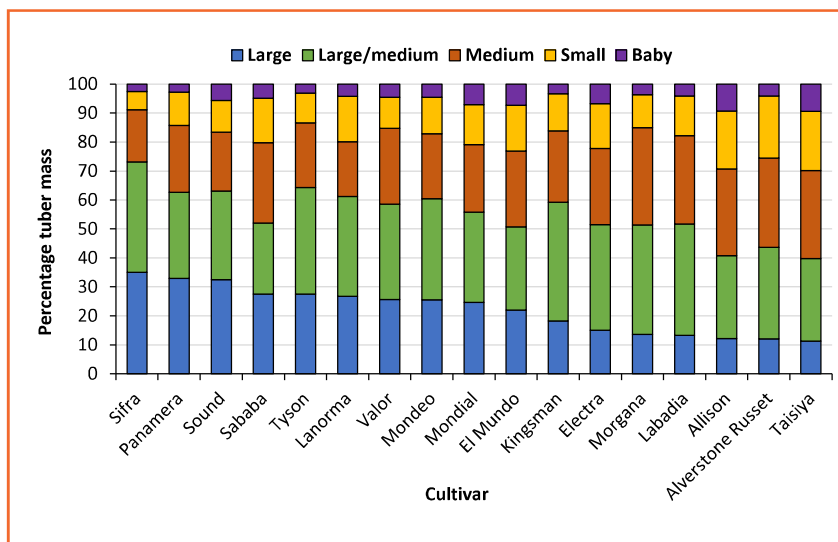
The majority of the yield comprised large/medium- and medium-sized tubers (Figure 12). However, overall, yield was significantly positively correlated to the percentage mass of large and large/medium tubers. Without fungicide applications, the percentage mass of the large and large/medium tubers decreased significantly, while the percentage mass of the medium, small and baby tubers increased significantly (Figures 10 and 11).

Fungicide treatment did not significantly affect the percentage mass of large tubers produced by Allison, El Mundo, Electra, Labadia, Morgana, Sababa, Sound and Taisiya. Without fungicide applications, Alverstone Russet produced no large tubers.

The percentage of large/medium-sized tubers decreased significantly for Alverstone Russet, Kingsman, Mondeo, Morgana and Taisiya when no fungicides were applied, indicating that these cultivars had poor tolerance to blight. Without fungicides, more than 50% of the tuber mass produced by Alverstone Russet and Taisiya was graded Small and Baby.

Due to higher disease pressure in the 2020/2021 growing season compared to the two previous growing seasons, the mean yield was significantly lower (44.54 t/ha vs 54.25 t/ha and 50.02 t/ha, respectively).

Figure 12: Percentage tuber mass of total yield at the five size grades for the 17 cultivars sprayed with fungicides.



Without fungicides, the mean yield was 11.2 t/ha lower.

When comparing the effects of the two fungicide treatments on the yield of individual cultivars, no significant differences were measured for Electra, Sababa, Sound, El Mundo, Morgana and Taisiya (Figure 13).

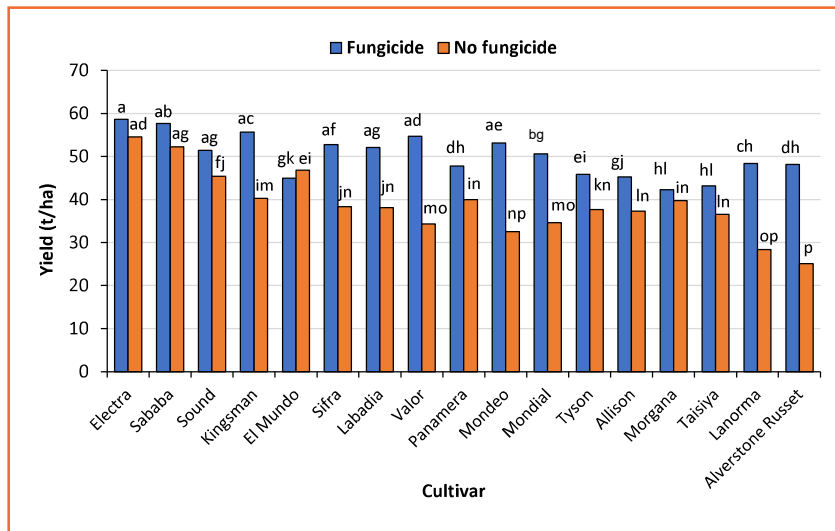
In previous seasons, significantly lower yields were produced by Taisiya when no fungicides were applied. Valor showed good tolerance to late blight in the two previous seasons, but this season the yield was 20.37 t/ha lower when no fungicides were applied. Alverstone Russet,

Mondeo and Lanorma also had a >20 t/ha reduction in yield without fungicide applications.

To optimise production and profitability, potatoes grown in the KwaZulu-Natal Midlands must be sprayed regularly with fungicides to control late and early blight. Although no significant differences in yield were measured between the fungicide treatments for some cultivars, the differences were large enough for it to be financially advantageous to apply fungicides, considering the current prices being obtained for table potatoes, with the exception of El Mundo.

Resource-poor household producers, who cannot afford to purchase fungicides, should grow Electra, Sababa or El Mundo. 🍅

Figure 13: Yield of the 17 cultivars with the two fungicide treatments in the 2020/2021 growing season.



For more information, contact the KwaZulu-Natal Department of Agriculture and Rural Development at 033 355 9100.

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