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Alternaria species causing leaf blights on potatoes in South Africa: Are they still sensitive to fungicides?

By Dr Elsie Cruywagen, ARC-VIMP

Alternaria diseases (early blight and brown spot) are the most troublesome foliar diseases on potatoes in South Africa. Currently, fungicides play a critical role in the management of these diseases and at the same time, reports of tolerance to some classes of fungicides have been published in North America and Europe, with particular reference to the quinone outside inhibitors (QoI) and succinate dehydrogenase inhibitors (SDHI) groups.

Reduced sensitivity to fungicides in some South African *Alternaria alternata (A. alternata)* isolates was first reported in 2013 (Dube *et al*., 2014). However, there is no current information on the status of sensitivity to fungicide of *Alternaria solani (A. solani)*, or any of the other Alternaria species on potatoes in South Africa. Up-to-date information on the fungicide sensitivity of *A. alternata* from different geographic regions is also lacking, as fungi in different areas may have developed resistance to different classes of fungicides.

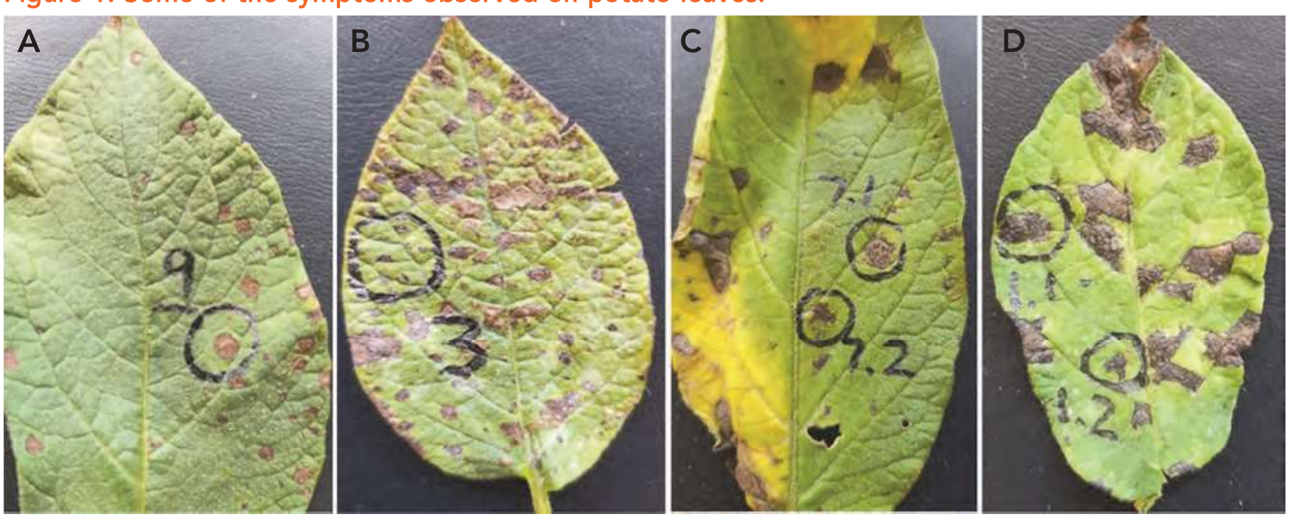
Table 1: Classes of fungicides used in this study with their Fungicide Resistance Action Committee (FRAC) codes and the level of risk for fungicide tolerance, adapted from the FRAC code list of 2018.

Common name	Group name	FRAC mode of action code	Level of risk according to FRAC
Procymidone	Dicarboximides	2	Medium to high
Tebuconazole	DeMethylation inhibitors (DMI) fungicides	3	Medium
Fluopyram	SDHI	7	Medium to high
Azoxystrobin	QoI fungicides	11	High
Fentin hydroxide	Organotin compounds	30	Low to medium

Collection, identifying, and testing of *Alternaria* isolates

This study aims to collect symptomatic potato leaves from all potato production areas in South Africa, and to isolate and identify the pathogenic *Alternaria* isolates

Figure 1: Some of the symptoms observed on potato leaves.



The brown spot pathogen, A. alternata, was isolated from A and B; the early blight pathogen, A. solani, was isolated from C; and both pathogens were isolated from D.

to species level. These isolates are then tested for sensitivity against five groups of fungicides registered for the control of early blight in South Africa (*Table 1*).

This article reports on results of the first phase of the study, namely to screen *Alternaria* isolates for tolerance to fungicides of five groups in vitro.

Symptomatic potato leaves (*Figure 1*) were collected from 37 farms in eight production regions (Table 2).

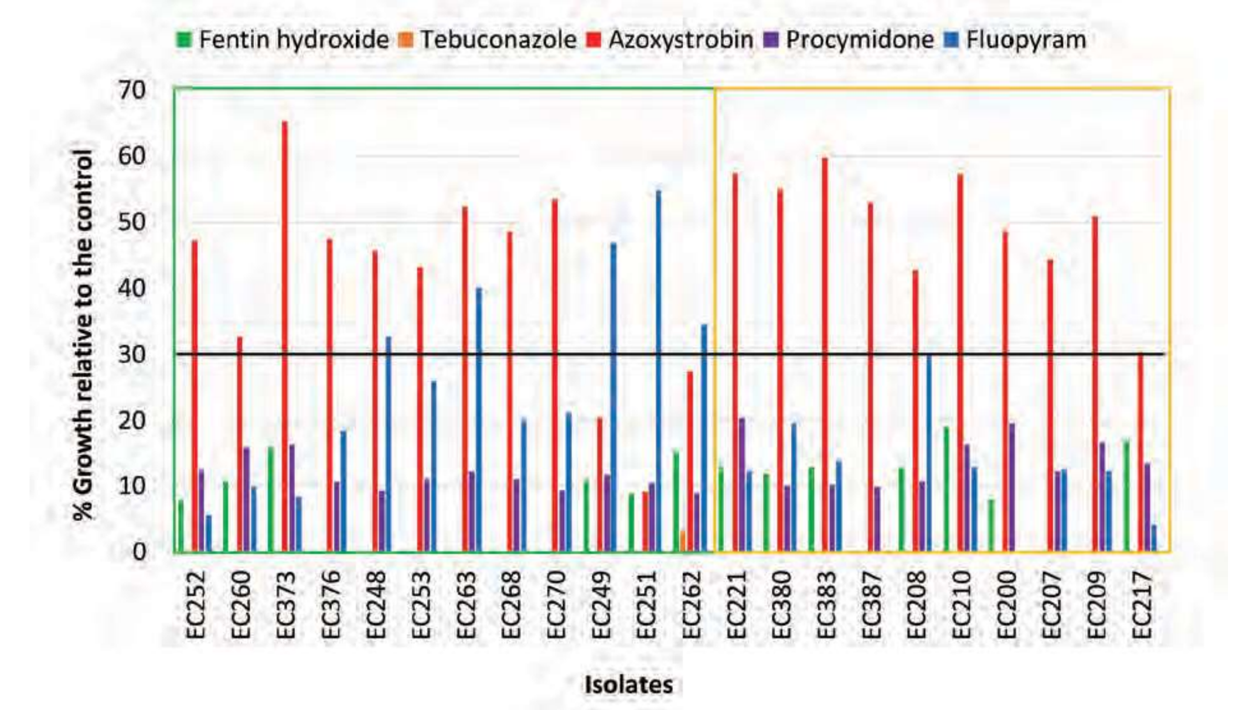
In-vitro screening of isolates

Alternaria isolates from the Eastern Free State (*Figure 2*), Limpopo (*Figure 3*), Sandveld (*Figure 4*), as well as Gauteng and Mpumalanga (*Figure 5*), the Southwestern Free State (*Figure 6*), and KwaZulu-Natal (*Figure 7*) have been screened in vitro against five classes of fungicides registered for control of early blight on potato in South Africa. Five replicates of selected isolates were plated out and incubated at 25°C for five days, whereafter the diameter of fungal

Table 2: Regions where samples were collected and the number of *Alternaria* isolates obtained from each area.

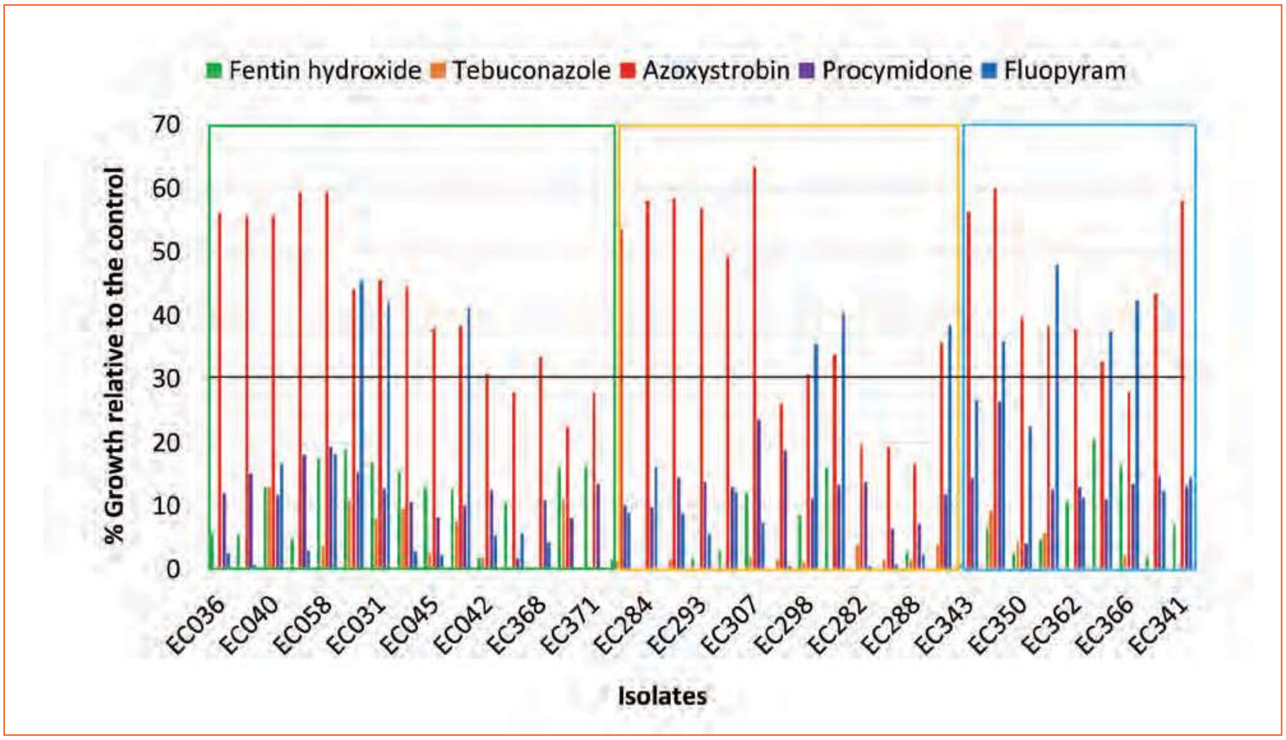
Potato production region	Area	No. of farms	No. of isolates
Limpopo	Vivo, Dendron	3	33
Limpopo	Maasstroom, Swartwater	3	21
Limpopo	Marble Hall	3	32
Mpumalanga	Middelburg	3	49
Western Cape	Sandveld	9	108
Eastern Free State	Reitz, Petrus Steyn, Harrismith	5	122
KwaZulu-Natal	Mooi River, Cedara	4	85
Southwestern Free State	Petrusburg	3	117
Northeastern Cape	Ugie, Maclear	3	57
Gauteng	Roodeplaat	1	29
Total		**37**	**653**

Figure 2: The average percentage of growth after five days of five replicates each of *Alternaria* isolates from the Eastern Free State on media amended with different classes of fungicides.



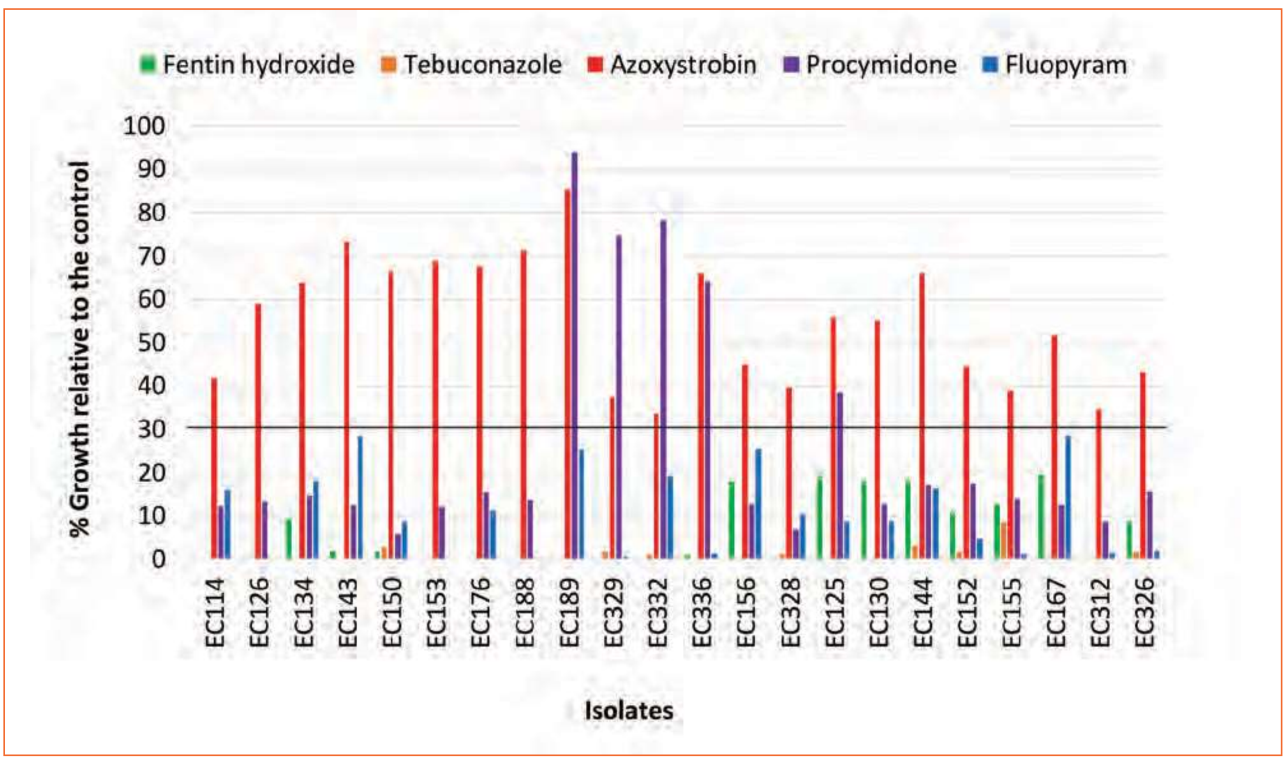
Values of more than 30% growth (black line) are an indication of loss of sensitivity to the fungicide tested. Isolates in the green block were obtained from the Harrismith area, and isolates in the orange block were obtained from the Reitz area.

Figure 3: The average percentage of growth after five days of five replicates each of *Alternaria* isolates from Limpopo on media amended with different classes of fungicides.



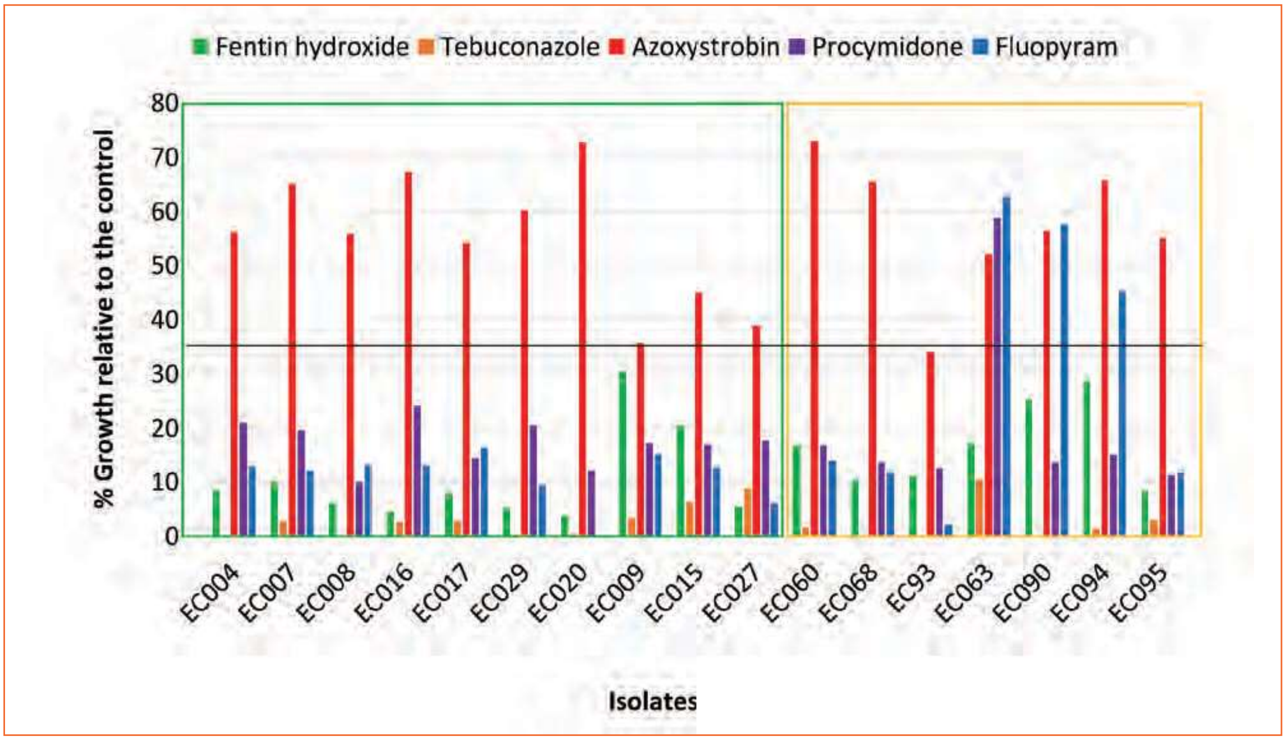
Values of more than 30% growth (black line) are an indication of loss of sensitivity to the fungicide tested. Isolates in the green block were obtained from the Dendron and Vivo areas, isolates in the yellow block were obtained from the Marble Hall area, and isolates in the blue block were obtained from the Swartwater, Tom Burke, and Maasstroom areas.

Figure 4: The average percentage of growth after five days of five replicates each of *Alternaria* isolates from the Sandveld area on media amended with different classes of fungicides.



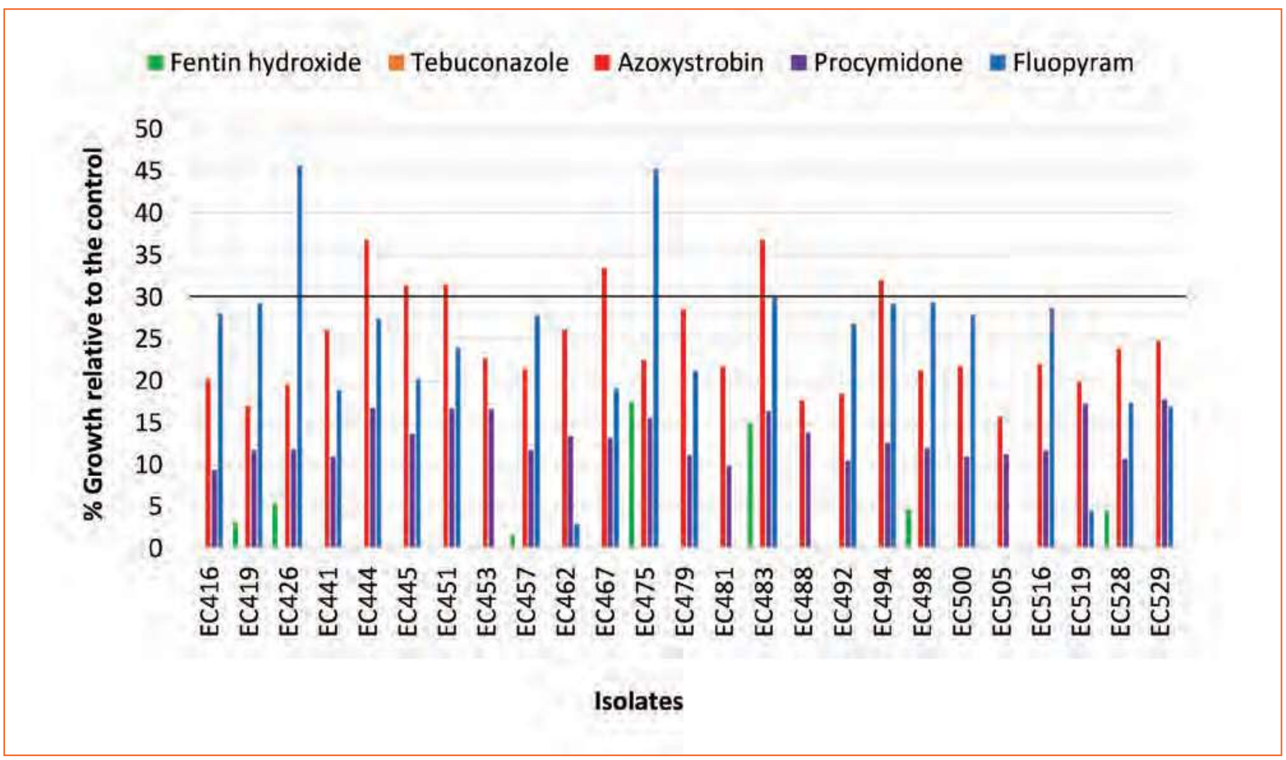
Values of more than 30% growth (black line) are an indication of loss of sensitivity to the fungicide tested.

Figure 5: The average percentage of growth after five days of five replicates each of *Alternaria* isolates from Gauteng (green block), and Mpumalanga (Middelburg area – yellow block) on media amended with different classes of fungicides.



Values of more than 30% growth (black line) are an indication of loss of sensitivity to the fungicide tested.

Figure 6: The average percentage of growth after five days of five replicates each of *Alternaria* isolates from the Southwestern Free State on media amended with different classes of fungicides.

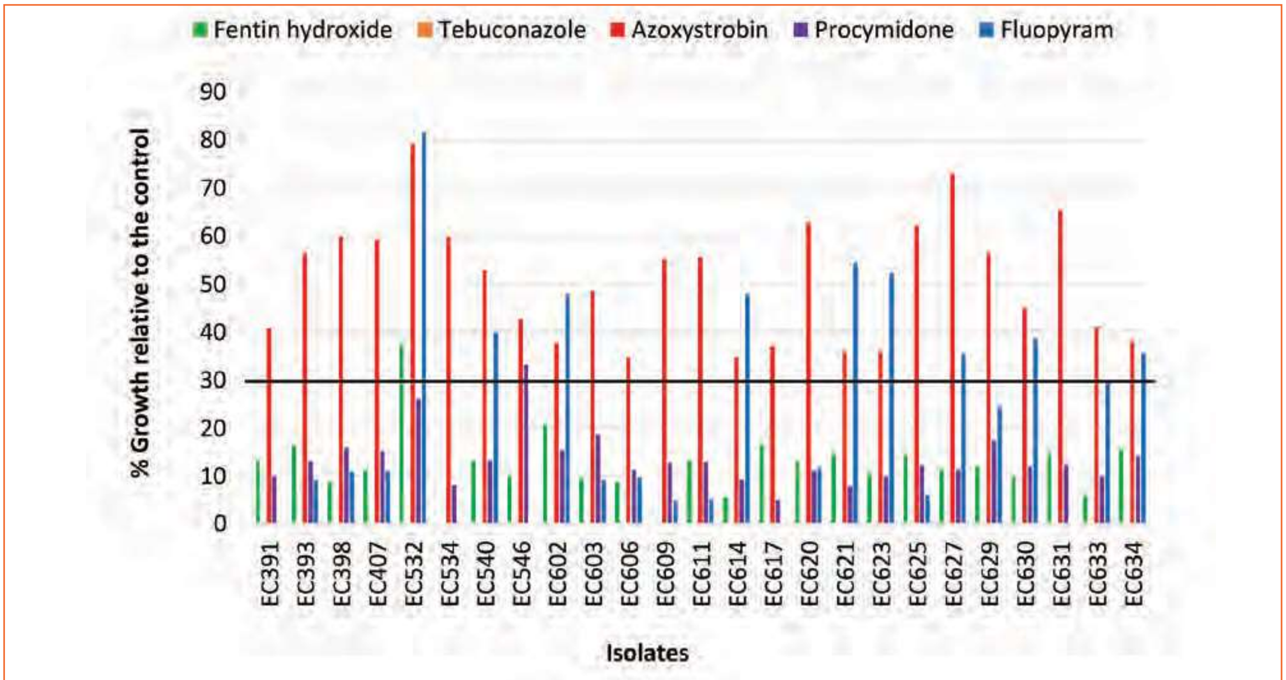


Values of more than 30% growth (black line) are an indication of loss of sensitivity to the fungicide tested.

Table 3: Classes of fungicides used in this study with their FRAC codes and the level of risk for fungicide tolerance according to FRAC.

FRAC code	Common name	No. of registrations	Risk level
2	Procymidone	3	Medium to high
3	Difenoconazole	10	Medium
	Flutriafol	2	
	Tebuconazole	19	
7	Fluopyram	2	Medium to high
11	Azoxystrobin	11	High
	Picoxystrobin	2	
	Trifloxystrobin	1	
29	Fluazinam	1	Low
30	Fentin hydroxide	1	Low to medium
40	Iprovalicarb	1	Low to medium
NC	Potassium bicarbonate	1	–
M01	Copper ammonium acetate	5	Low risk group – no signs of resistance developing
	Copper hydroxide	9	
	Copper oxychloride	8	
	Copper sulphate	2	
	Cuprous oxide	2	
M03	Propineb	1	
	Mancozeb	23	
M04	Folpet	4	
M05	Chlorothalonil	14	
	Cymoxanil	1	
1 & 3	Carbendazim + difenoconazole	2	High, medium
11 & 3	Azoxystrobin + difenoconazole	3	High, medium
11 & 3	Azoxystrobin + tebuconazole	1	High, medium
11 & M03	Fenamidone + mancozeb	1	High, low
11 & M05	Azoxystrobin + chlorothalonil	2	High, low
3 & 11	Tebuconazole + trifloxystrobin	1	Medium, high
7 & 11	Boscalid + pyraclostrobin	1	Medium to high, high
9 & 11	Pyrimethanil + trifloxystrobin	2	Medium, high
M03	Maneb + zinc oxide	3	Low
M03 & 2	Maneb + procymidone + zinc oxide	1	Low, medium to high
M05 & M05	Chlorothalonil + cymoxanil	1	Low
M05 & 11	Chlorothalonil + fluoxastrobin	1	Low, high
M05 & 11	Cymoxanil + famoxadone	2	Low, high
M05 & 11, M04	Cymoxanil + famoxadone + folpet	1	Low, high, low
M05 & 40	Chlorothalonil + dimethomorph	1	Low, low to medium
M05 & M01	Chlorothalonil + copper oxychloride	1	Low

Figure 7: The average percentage of growth after five days of five replicates each of *Alternaria* isolates from KwaZulu-Natal on media amended with different classes of fungicides.



Values of more than 30% growth (black line) are an indication of loss of sensitivity to the fungicide tested.

growth was measured in two perpendicular directions, giving ten measurements per isolate.

Results are presented as the percentage of growth of isolates on fungicide-amended media, compared with the control with no fungicide added. Initial results of the screening of fungicides have confirmed widespread shift in sensitivity to the QoI (azoxystrobin) fungicide. Several isolates from the Eastern Free State, Southwestern Free State, KwaZulu-Natal, Limpopo, and Mpumalanga also showed a high prevalence of loss of sensitivity to the SDHI (fluopyram) fungicide.

No current information on the status of sensitivity to fungicide of Alternaria species on potatoes in South Africa is available.

Sandveld, Mpumalanga, and KwaZulu-Natal are thus far the only regions where isolates less sensitive to dicarboximide (procymidone) fungicides have been isolated. While most isolates are still susceptible to organotin (FRAC 30), some isolates do grow on this media, and one isolate tested from KwaZulu-Natal lost sensitivity to FRAC groups 7, 11, and 30.

The widespread loss of sensitivity to fungicides commonly used to control early blight and brown spot is concerning, and the study highlights the importance of the application of proper resistance management regimes by all producers, as isolates that acquire tolerance in one region can be disseminated to other areas.

Screening of isolates from the other regions is ongoing and samples will be collected from these potato production regions during 2020/21. In the next phase of this study, molecular methods will be used to confirm the mutations conferring tolerance to the isolates.

Early blight and brown spot are the most troublesome foliar diseases on potatoes in South Africa.

Acknowledgements

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For a list of references and more information, contact Dr Elsie Cruywagen on 012 808 8000 or elsie@arc.agric.za.