Potatoes Aartappels SA

Alternaria diseases

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ALTERNARIA DISEASES

The genus *Alternaria* is the single most widespread plant pathogenic fungal genus in the world, with a wider host range than other fungal pathogens. Early blight and brown spot occur wherever potatoes are grown in South Africa; however, brown/ black pit on tubers is not common in South Africa.

Early blight (target spot) in potatoes, caused by *Alternaria solani,* has been known to pathologists since the late 1800s, with the cause of early blight in South Africa being confirmed in 1950. The name 'early blight' is not an indication of the time in the season when the disease becomes a problem, but refers to the fact that it was originally found to have a more profound effect on early maturing cultivars than on cultivars growing for a longer period. As a major foliar disease of potatoes in South Africa and most other parts of the world, early blight normally becomes a problem in the second half of the growing season when plants are stressed.

Brown spot is a relatively new foliar disease of potatoes and is caused by *Alternaria alternata.* Brown spot was described for the first time in 1984 in Israel and subsequently in Brazil, China, the USA and other countries, while in South Africa the cause of brown spot was confirmed in 2011 by a team at the University of Pretoria. Brown spot is sometimes called the 'other early

blight'. The Afrikaans term, 'malroes' (direct translation: "mad" or "crazy" blight), probably originates from the devastating effect that the disease was seen to have on yield, and the rapid rate at which it spreads.

Black/brown pit on tubers can also be caused by either *A. solani or A. alternata*. However, the symptoms develop during long-term storage of tubers, and the disease is not commonly reported in South Africa.

DAMAGE

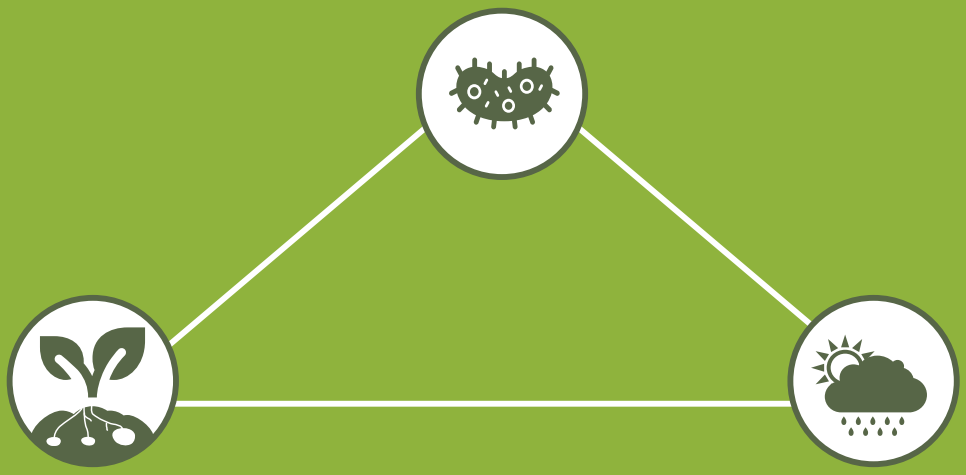
Both *A. solani and A. alternata* cause lesions on leaves which reduce the plant's ability to photosynthesise. If these diseases are not controlled, the result can be an approximate 20 – 50% loss of yield.

Tuber infection can result in degradation, and in some cases yield loss as a result of rotting due to invasion by secondary organisms.

DISEASE TRIANGLE

PATHOGENS

- *A. solani and A. alternata* are polycyclic, opportunistic pathogens
- A. alternata has a very wide host range
- Spores are spread by wind, water, insects and plant material
- Both pathogens are saprophytic, surviving on plant debris and in soil



HOST PLANT

- No resistant cultivars are available
- The susceptibility of locally grown cultivars varies
- Stressed and weak plants are most susceptible to brown spot and early blight
- Leaves, stems and tubers are infected

ENVIRONMENT

- Periods of leaf wetness are essential for infection and the production of spores
- Dry periods are required for the spreading of spores

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MANAGING THE RISK OF EARLY BLIGHT AND BROWN SPOT

PLANTING TIME

RISK	MANAGEMENT
Climate is favourable for disease development	• Potatoes planted during midsummer will probably mature during autumn when heavy dew is common. Follow a preventative spraying programme from early on in the season. • Make sure that plants grow under optimal conditions in order to reduce stress.

CHOICE OF LAND

RISK	MANAGEMENT
Alternaria inoculum on plant debris and soil surface	• Plant debris and weeds must be removed or ploughed in deeply after harvesting to reduce the inoculum level on the soil surface. • Keep to a rotation period of 4 – 5 years with non-host plants.
Source of *Alternaria* near the field	• Volunteer plants, weeds and alternative host plants should be controlled to keep the inoculum level in the region as low as possible. • Avoid planting potatoes near fields with older potato plantings, especially if the climate is favourable for disease development.

CHOICE OF CULTIVAR

RISK	MANAGEMENT
Susceptible cultivars	Where possible, plant cultivars that are known to be less susceptible to *Alternaria*.

SEED POTATOES

RISK	MANAGEMENT
Uncertified or old seed potatoes	• Poor seed gives rise to weak plants predisposed to Alternaria diseases. Plant only good-quality, certified seed potatoes.

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MANAGING THE RISK OF EARLY BLIGHT AND BROWN SPOT

CROP MAINTENANCE

RISK	MANAGEMENT
Plants weakened by external stress factors	• Ensure that the fertiliser programme provides well-balanced nutrition, particularly during the early stage of the season. • Apply irrigation judiciously to avoid overly wet or dry conditions.
Plants predisposed to infection during tuber bulking	Ensure that spraying starts at row cover to reduce inoculum pressure when tubers start to bulk.
Impaired root function	• Control soil-borne diseases and nematodes, as infection by these pathogens will impair root function and subsequently nutrient and water uptake, thus weakening the plants. • Avoid low-lying areas prone to water-logging.
Wounding of foliage	• Wounds caused by wind, as well as micro-wounds caused by windblown sand and dust particles, and damage caused by insects, increase the access of Alternaria spores access to the leaf tissue. • Control leaf-eating insect pests such as leaf miners. • Apply an appropriate fungicide as soon as possible after wind, dust, or hail storms.
Climate favourable for disease development	Follow an effective spraying programme from the start.
Spore dispersal	Air currents and wind spread spores during periods of low humidity. Ensure that an effective spraying programme is in place to reduce the risk of infection.

MANAGING THE RISK OF EARLY BLIGHT AND BROWN SPOT

HARVESTING

RISK	MANAGEMENT
Tubers infected during harvesting	• If tubers are to be stored, harvest only after proper skin setting has occurred, and in such a manner that mechanical damage is limited to a minimum. • Do not harvest when the soil is wet, so as to prevent any inoculum in the soil from adhering to tubers.

POST- HARVEST TILLAGE

RISK	MANAGEMENT
Spores on plant debris and soil as source of inoculum	• Plough in plant debris if potatoes are still growing in other fields, or if potatoes will be planted in the area in the subsequent season. • Control volunteer potatoes, as they will serve as a continuous source of inoculum

DISEASE DEVELOPMENT

Alternaria diseases on potatoes in South Africa

A. alternata and A. solani are both opportunistic pathogens, the implication being that young, healthy plants are less likely to become diseased than older, stressed plants. *A. solani* is considered to be the more aggressive pathogen of the two. If both pathogens are present, *A. alternata* will be out-competed by *A. solani*.

Early blight is known to be a disease of older plant tissue and is more prevalent on senescing tissue, or plants that have been subjected to stresses induced by injury, poor nutrition, insect damage or other causes. Symptoms appear first on older leaves, or those near the soil surface.

When plants mature, disease pressure increases, and as plants get older and more susceptible to infection, the younger leaves also become diseased. In production regions where heavy dew occurs towards the end of the production season, early blight can be a severe problem.

In South Africa, brown spot commonly occurs earlier in the season than early blight and young leaves can become the diseased first. Leaves closest to the soil surface can become diseased first as wet soil and the protection by the top growth create a micro-climate with high humidity.

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Disease cycle

Alternaria alternata and A. solani are closely related pathogens and share many characteristics. The discussion that follows will therefore cover both species, highlighting the differences between them.

- Both *A. solani* and *A. alternata* survive as conidia (spores) and mycelia on infected plant debris, in soil, on tubers or volunteer potatoes, or on other Solanaceous hosts between growing seasons. Spores can withstand a range of environmental conditions such as sunlight and repeated cycles of drying, freezing and thawing.
- Primary infection is commonly caused by spores spread by wind or splashed by rain and irrigation.
- If the spores land on susceptible leaves or stems, they will germinate when sufficient free moisture is present on the leaf surface with high humidity and suitable temperature.
- For *A. solani*, suitable temperatures are between 10 and 30°C, with the optimum being 25°C. For A. alternata infection can take place at temperatures of 10–40°C, with the optimum being 20–30°C. The time required for infection varies depending on the susceptibility of the host tissue, but for *A. solani* it can be as short as 40 minutes at a temperature of 28–30°C and with the presence of free moisture.,
- The germ tubes enter the leaf through stomatal openings or micro-wounds caused by feeding insects or wind-blown dust and sand particles, or they can penetrate the cell wall directly and enter epidermal cells. Once inside the leaf, mycelium grows between the cells and feeds on the cell contents, leaving dead tissue in the lesions.
- Spore formation occurs during long, wet periods at temperatures of 5–30°C. For A. solani, the optimum temperature is at around 20°C, while for A. alternata the optimum is around 27°C.
- The conidiophores (spore-bearing micro-stalks) protrude above the diseased plant tissue, and the spores are passively removed by wind, water droplets or insects during periods of low relative humidity.
- The spores can land on the same plant to start another disease cycle, or on other plants in the same field to cause multiple disease cycles. Early blight and brown spot are polycyclic diseases, and epidemics can thus develop in a very short period of time.
- The air-borne spores are spread by air currents or wind over long distances. Insects or water droplets spread spores between plants within the field.
- Tubers are infected through wounds in the skin, particularly when harvested from wet soil.

Conditions conducive to disease development

The diseases develops most rapidly during periods of alternating wet and dry weather, particularly in light soils. Warm, moist conditions are optimal for infection, whereas rain, heavy dew and irrigation promote the spread of Alternaria diseases. Plants that are physiologically old, weak, malnourished or damaged by wind, sand, hail or insects are the most susceptible. Potato cultivars are known to vary in susceptibility to Alternaria species,but the relative susceptibility of the most popular cultivars in South Africa has not been tested.

SPORE SURVIVAL

Soil and plant debris

Alternaria species overwinter saprophytically as mycelium or spores on dead plant tissue in potatoes and other host plants.

International data indicate that *Alternaria* species can survive on the soil surface for up to eight months. However, no studies have been done to determine for how long *Alternaria* spores can survive on soil and plant debris under local conditions.

Volunteer potatoes

Volunteer potatoes will raise the inoculum level of the entire area, as the disease will most probably not be controlled where they grow.

Other host plants

A. alternata has a wide host range, including cherry, citrus, cotton, kiwi, pistachio, sunflower and members of the Solanacea family. Host plants of A. solani are mostly limited to tomatoes and some other solanaceous crops, including weed species.

SPREAD OF ALTERNARIA DISEASES

- The spreading of spores by wind follows a diurnal pattern. Spores are formed during the night and are dispersed by wind as the temperature increases and the relative humidity decreases in the morning and at midday.
- Spores can be spread within fields by water droplets during rain and irrigation.
- Although spreading by insects is not the most significant manner of spreading of the disease, spores can adhere to the bodies of insects and be spread from one plant to another and amongst different plantings.

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PRINCIPLES OF DISEASE MANAGEMENT

The following characteristics of *A. solani* and *A. alternata* play a critical role in disease management:

- · Both species are opportunistic, polycyclic pathogens (various cycles of infection are possible during the growing season).
- · Spores are spread by wind.
- · Epidemics can develop in a very short time if the weather is favourable for disease development.

Control of *Alternaria* diseases is possible only through an integrated strategy in which fungicides play an indispensable role.

Keep plants healthy to avoid stress-induced susceptibility

- Keep plants healthy through optimal fertilisation (avoid excessive or too little nitrogen). Observations in different production regions indicate that deficiency or toxicity of micro-elements may predispose plants to infection by *A. alternata*.
- Irrigate judiciously, as plants that are too wet or too dry are more susceptible to infection. Avoid irrigating late in the afternoon, as plants should be dry by sunset to reduce spore formation.
- Plants with weak root systems are susceptible to infection by *Alternaria spp.*, because water and nutrient uptake is suboptimal. Nematodes and soil-borne diseases such as Fusarium-and Verticillium wilt weaken the root system. Control nematodes, and plant in soils with a low risk of soil-borne diseases.
- Some cultivars are less susceptible than others, but no commercial cultivar available in South Africa is resistant to early blight and brown spot.
- Control insects to reduce stress and wounding.
- Chemical compounds that stimulate systemic-acquired resistance in plants can be incorporated in spraying programs.

Reduce inoculum pressure for as long as possible

- Plant certified seed potatoes. Harvest mature tubers where the skin has set and avoid wounding.
- Irrigate judiciously, as leaves should not remain wet overnight.
- Due to the pathogen's ability to survive in the soil and on plant debris, crop rotation periods of 4 – 5 years are recommended. Rotate with a non-host crop to reduce the inoculum.
- Do not plant potatoes near fields with senescing or diseased host plants, as spores can be blown into the field and increase the inoculation level.
- Bury infected plant residues as soon as possible after harvesting by ploughing them into the soil.

Apply a preventative fungicide spraying programme

- No fungicide is currently registered for the control of brown spot. However, numerous chemicals are registered for the control of early blight.
- Use fungicides registered for early blight control in a preventative spraying programme.
- Control can be effective, provided fungicides are applied at the right time. If application starts when the inoculation pressure is already high or if plants are weakened and weather conditions favour disease development, success is limited or impossible.
- Protective spraying should begin at row closure, as the canopy creates a micro-climate of high humidity. Leaves near the soil surface are particularly prone to infection at this stage.
- The inclusion of remedies that stimulate the systemic resistance of plant tissue has proven to be beneficial in spraying programmes.
- The resistance of *Alternaria spp.* to certain fungicides can make effective control very difficult and may ultimately lead to the withdrawal of very good remedies by the chemical companies. Resistance has been reported in several countries around the world, including South Africa. It is very important to apply fungicides according to the label instructions. Do not apply a specific fungicide more often in a season than recommended, as this practice lead to the selection of genes with resistance to that particular active ingredient.

BROWN SPOT IS NOT TO BE CONFUSED WITH NUTRIENT DEFICIENCY OR TOXICITY

Symptoms of brown spot can sometimes be confused with those of magnesium deficiency, manganese toxicity or deficiency, or zinc deficiency.

Symptoms of **magnesium** deficiency are initially observed as yellowing between the veins of the older leaves, after which the lesions begin to turn brown. In severe cases, the lesions can become necrotic over time.

Manganese is not very mobile in plants. The first symptom is an initial paleness in the younger leaves, followed by the appearance of blackish/brown spots along the veins, particularly visible on the underside of leaves.

Zinc-deficient potato plants show interveinal chlorosis and necrosis in irregular patches, with whitish spots developing within the brown necrotic tissue. Symptoms may start in both younger and older leaves.

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SYMPTOMS OF EARLY BLIGHT AND BROWN SPOT

Symptoms of early blight are observed on leaves as dark brown or black lesions (5 – 15 mm in diameter), with characteristic concentric rings producing a "target spot" effect (6). Over time the leaf lesions enlarge and coalesce (7), eventually causing the leaf to die. **Brown spot lesions** are usually first seen on the underside of leaves and on those nearest the soil surface, or in areas where water collects on the leaf surface.

Lesions are initially small (the size of a pinhead), irregular to circular in shape, brown in colour, and water soaked (1, 4). Over the course of a few days, the lesions enlarge and can be seen on the upper sides of the leaves (5). Lesions on stems are initially small (2), but increase in size to form large lesions with necrotic tissue (3). Tuber lesions **(black pit)** are small in size (5–10 mm in diameter), circular in shape, and dark brown to black in colour, appearing dry and slightly sunken (8).

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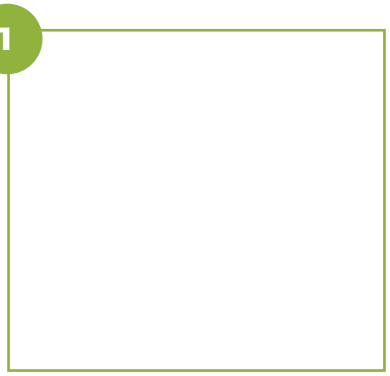

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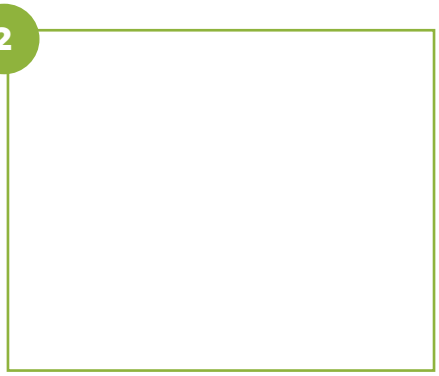

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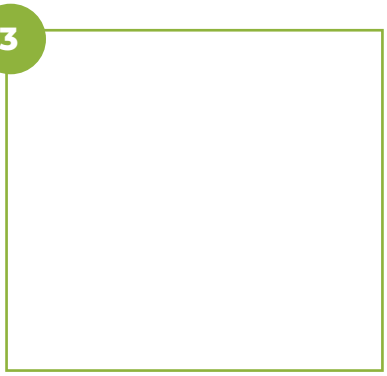

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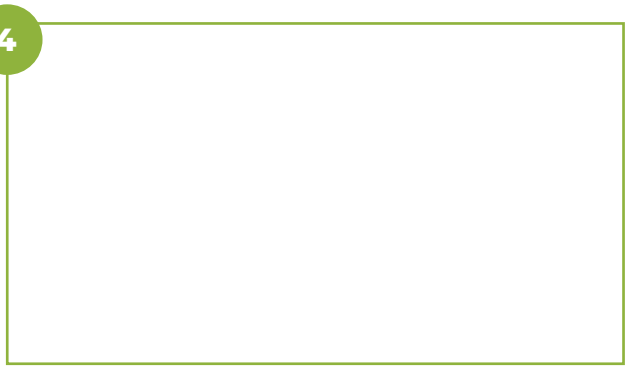

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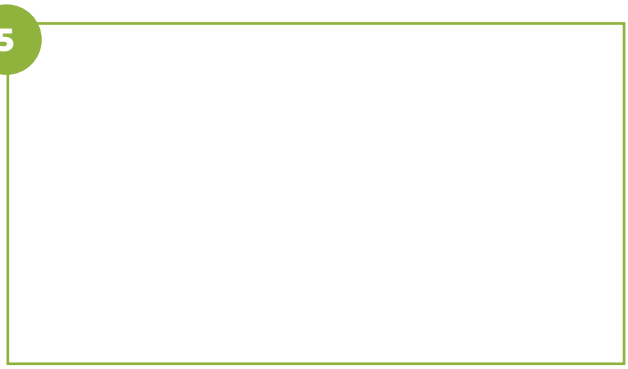

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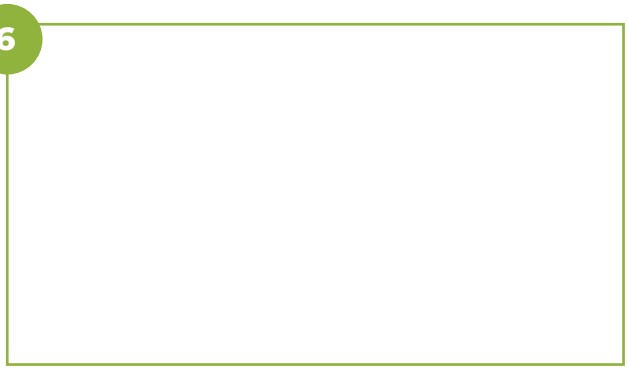

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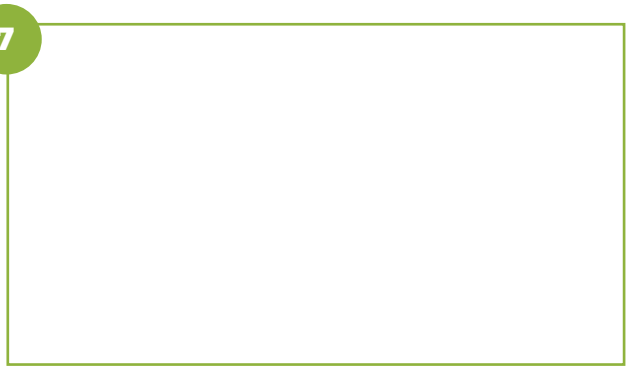

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