

## Lettuce downy mildew

### Downy mildew causal organisms

The oomycete *Bremia lactucae* is an obligate (can only live on living plant tissue) pathogen.

### Disease symptoms



The older leaves are usually the first infected, developing scattered, angular, pale green to yellow areas (delimited by the veins) of variable size on the upper side of the leaf.

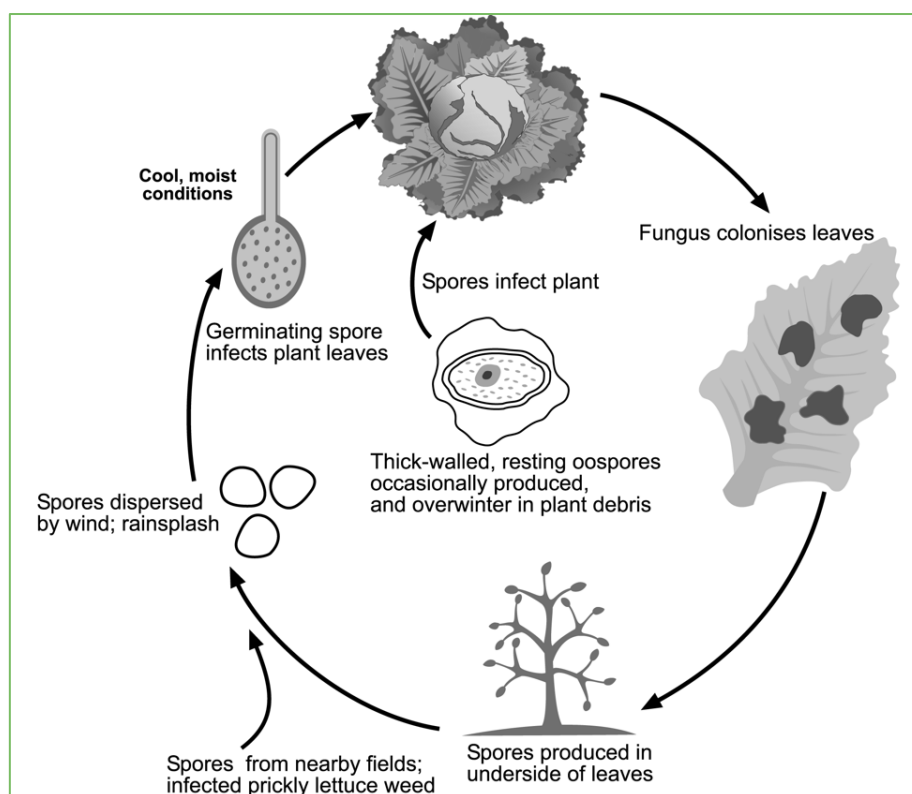


The patches turn light brown and when they converge, the leaves die. Damaged tissues are readily infected by soft-rotting bacteria in wet conditions.



A downy white fungal growth (spongiophores) occurs mainly on the lower surface of the leaf before or after chlorotic spots become visible.

### Downy mildew disease cycle



## Conditions that favour the disease

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- Spread of downy mildew is by spores (sporangia); these are produced at night and in the morning, released from their sporangiophores, and blown in the wind to plants nearby and over long distances.
- The spores do not live for long – for successful infection, leaves need to be wet for 3–4 hours.
- Sporangia germinate in the presence of free water. 10–15°C is optimum for germination of sporangia.
- Sporangia grow a germination tube, which directly penetrates the cuticle and epidermal cells. Infection takes place within 2–3 hours. The mycelium progressively invades and destroys the leaf cells.
- Bushy sporangiophores, carrying the sporangia, emerge from the stomata. They can be seen as the characteristic downy white matting. Appearance of sporangiophores and sporangia requires high humidity.
- Sporulation can be intense if temperatures are 5–10°C at night followed by daytime temperatures of 12–20°C.
- Sporangia are liberated in warm, dry conditions and carried by the wind to infect neighbouring or more distant lettuce plants.

## Disease management

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- Crop Rotation. Resting spores in crop residues help carry the fungus from season to season, so rotation (>3 years) with non-host crops will help reduce carry-over of the pathogen.
- Carefully check each seedling before transplanting in the field and remove any that show downy mildew symptoms. If symptoms are seen, spray all the seedlings with a systemic fungicide.
- Avoid planting lettuce cell transplants in poorly drained soils. Plant in well-prepared and level ground that provides even distribution of water and facilitates good drainage.
- Raised beds will reduce water/humidity around the lettuce plants.
- Irrigation should be carried out preferably in the morning and early afternoon (never in the evening) to allow plants to dry out as soon as possible.
- Canopy management: Wider row spacing, rows arranged in the direction of prevailing winds, and lower plant density, can be used to improve air flow and decrease humidity around the plants.
- Avoid excessive nitrogen fertiliser application, which can result in lush, succulent plants that are more prone to downy mildew infection (and other pathogens).
- Fungicide treatments should be initiated when conditions are favourable for the disease but before symptoms develop on the plants – particularly if downy mildew is present in nearby lettuce fields.
- Systemic fungicides may cause the appearance of fungicide resistant strains. Preventative fungicides are preferable as they have no resistance issue. Mancozeb is traditionally used in New Zealand but must be applied every week to be effective.
- Treatments should continue while conditions remain favourable. Because the lettuce downy mildew pathogen develops resistance to some fungicides, fungicides should be applied in combination or rotation with fungicides belonging to different mode of action groups (Fungicide Resistance Action Committee (FRAC) groups).
- Promptly remove crops after harvest to reduce plant debris.
- Plough-in crop debris to facilitate break-down of infected plant material.

## Summary

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- Recent strategies for control of downy mildew include the combined use of resistant cultivars and fungicides as well as agronomic practices that reduce foliar humidity.
- Protection is achieved mostly by preventive applications of pesticides with various numbers of treatments (five to eight) per cultivation cycle.
- However, due to pesticide impact on the human health and the environment, emerging pesticide-resistant strains, and stricter policies on levels of pesticide residues in agricultural products, new sustainable control strategies for lettuce diseases are needed.

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