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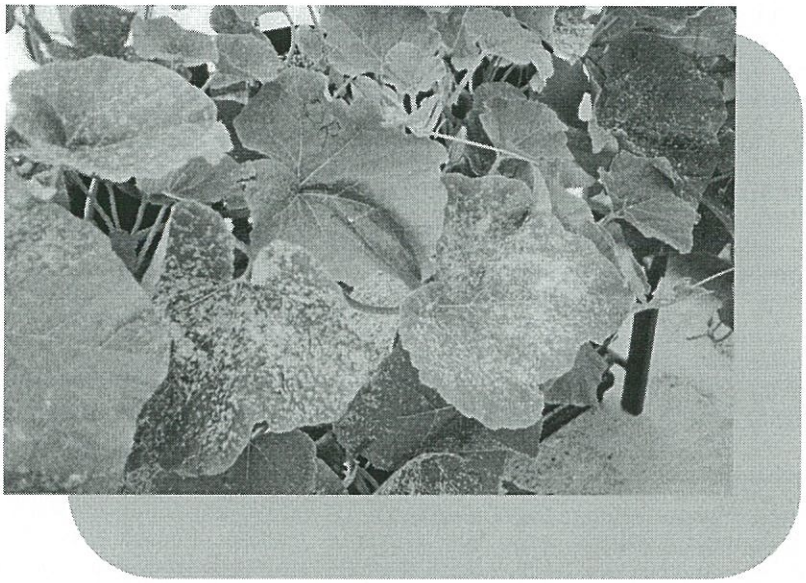
CROP & FOOD RESEARCH
Mana Kai Rangahau

Powdery mildew in squash



Early detection of powdery mildew followed by immediate fungicide application to reduce initial inoculum levels will minimise the effects of this disease in squash crops. Integrating cultural practices and chemical control is the best approach to powdery mildew control.

Powdery mildew is becoming a common and serious disease of New Zealand squash crops. Chemical control is the only method used by growers, but for the past three seasons growers have found it more difficult to control the disease despite regular applications of chemicals. The disease can kill the leaves, reducing the photosynthetic area. Severe cases defoliate plants, which reduces the dry matter of the fruit.

Epidemiology

Powery mildew of squash can be caused by two species of fungi. Early in the season *Erysiphe cichoracearum* is more common while later *Sphaerotheca fuliginea* is predominant. Conidia of *S. fuliginea* germinate at temperatures between 15 and 30°C, with the optimum at 25°C. Germination does not occur below 15°C or above 31°C, or at a relative humidity below 95%. Conidial germination requires a deposit of dew, but less than 3% germinate in waterlogged conditions. The symptoms first appear on old squash leaves seven to eight weeks after emergence, but appear progressively earlier, relative to the age of the leaf, on the later formed leaves. The disease is more severe in shade than in full light, in close plant spacings, and where luxuriant growth occurs because of high nitrogen levels.

The disease spreads via conidia. Many conidia are released soon after rainfall. Strong winds also increase conidia release and spread, but few conidia are released on calm days. In our trials the first signs of powdery mildew appeared approximately one week after a prolonged period of continuous leaf wetness (about 12 hours in duration) and high humidity (about 95%) in summer when temperatures frequently rose above 22°C.

Our field survey also showed that many growers plant zucchinis and cucumbers in glasshouses during winter and spring because they can fetch good prices. Most of these crops were infested with powdery mildew. In summer these growers also grew buttercup squash in the field, and the same staff worked on both glasshouse and outdoor cucurbit crops. This suggests that powdery mildew is most probably spread from glasshouse to field squash crops by people and machinery. No sexual state (cleistothecium) of the fungus has been found in New Zealand.

Disease cycle

Within a crop, conidia are spread from infected leaves to healthy leaves through rain and wind (Fig. 1). Conidia germinate under wet conditions and when the humidity is high. The presence of powdery mildew becomes evident when temperatures rise above 22°C. The fungi may survive as conidia or mycelium on a variety of cucurbit crops (Fig. 1). Weeds are not usually a source of powdery mildew for buttercup squash crops. The pathogen is more likely to survive from season to season on living cucurbits, spreading by wind blown spores.

Disease management

Cultural practices

Careful management of cultural practices is one of the important methods in an integrated approach to disease control. Any practices that can break the disease cycle will slow down or prevent the spread of powdery mildew. Practices such as crop rotation (to reduce the inoculum load and break the disease cycle), removal of infected plant debris (to reduce inoculum), removal of alternative hosts (to break the disease cycle), deep ploughing (to reduce inoculum), increasing air movement inside the canopy (to reduce relative humidity), reducing nitrogen fertiliser (to reduce relative humidity and increase light intensity) and early detection will help to control the disease. These methods are practical and at least one or a few of them can reduce powdery mildew on crops.

Chemical control

At least eight fungicides (Afugan 30EC, Bayleton 5DF, Benlate, Chlorothalonil, Saprol, sulfur, Taratek 5F and Topas) are registered for use on buttercup squash for the control of powdery mildew. Sulfur is still the most widely used, economic and effective chemical for disease control. Because the leaves of buttercup squash are rough and hairy it is recommended that some form of wetting agent or spreader (e.g. Du-Wett) is mixed with sulfur in a suspension when spraying. The development of systemic fungicides such as benomyl and demethylation inhibitor (DMI) fungicides (e.g. Saprol) has given a greater degree of control for longer periods of time. However, repeated use of these systemic fungicides has led to the evolution of fungicide-resistant strains of powdery mildew fungi. Resistance to benzimidazoles and DMI fungicides has been found in populations of *S. fuliginea* in the USA and Australia. It is, therefore, recommended that no more than two sprays of systemic fungicides, preferably in a mixture with a protectant, are applied to crops in one season. They should only be used when the risk of infection is high. It is very important to detect the disease early in a season and immediately apply protectant fungicides (e.g sulfur) in a large volume of water (300-400 ℓ/ha) to reduce the inoculum load. If the initial infection in a crop can be successfully controlled subsequent infection will be more easily managed.

Resistant cultivars

Considerable effort has been put into breeding cucurbit species with resistance to powdery mildew with some success amongst melon and zucchini varieties, but so far none amongst buttercup squash varieties.

Natural products

Concerns for public health, the environment and the occurrence of fungicide-resistant strains motivates growers and researchers to seek disease control strategies that use synthetic fungicides less. Foliar application of sodium bicarbonate, phosphate and potassium salts reduces the incidence of powdery mildew. Plant extracts of *Reynoutria sachalinensis* (giant knotweed plant) and two commercial products, Stylet oil (mineral oil) and Trilogy (neem oil), provided control of powdery mildew in glasshouse and field trials. In glasshouse tests we also found that rapeseed oil, olive oil and other plant extracts reduced powdery mildew incidence on squash plants.

Biological control

Much of the research into biological control has been done on glasshouse cucumber. At least 10 biological agents (e.g. *Ampelomyces* and *Tilletiopsis* spp.) are effective for the control of powdery mildew, but are not commercially available.

Integrated management

Integrated management is the best approach to disease control. Growers should incorporate some of the practices mentioned above into their growing methods to minimise the effect of powdery mildew on squash.

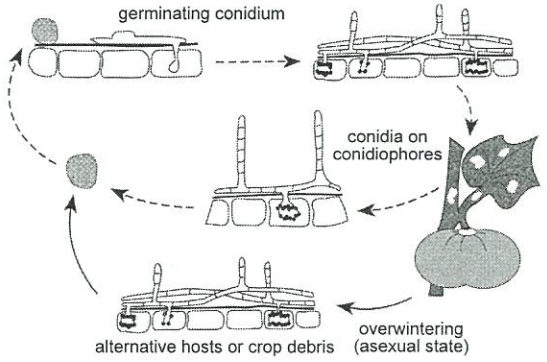


Fig 1: Powdery mildew; disease cycle of *Sphaerotheca fuliginea.*

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