STRATEGIES TO AVOID RESISTANCE DEVELOPMENT TO STROBILURIN AND RELATED FUNGICIDES IN NEW ZEALAND

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ABSTRACT

Strobilurins have a site-specific mode of action and there is potential for resistance to develop in target plant pathogenic fungi. STAR (strobilurin-type action and resistance) compounds form a cross-resistance group that is different to other commercially available fungicides. The first strobilurin was registered for use in New Zealand in 1997 and resistance has not yet been reported in this country. Resistance has been reported overseas in wheat powdery mildew, grape downy mildew, banana black Sigatoka and cucurbit powdery mildew. Strategies developed under the auspices of the New Zealand Committee on Pesticide Resistance (NZCPR) to promote the use of STAR compounds in a way which avoids or delays the development of resistance in pathogens of apples, grapes, other fruit crops, vegetables and cereals in New Zealand are described.

Keywords: fungicide resistance management, plant diseases, cereals, vegetables, fruit crops.

INTRODUCTION

Strobilurins are a relatively new group of fungicides which are synthetic derivatives of naturally occurring compounds (Anke *et al.* 1977) and have activity against a broad spectrum of fungi. They have a site-specific mode of action, being variously described as mitochondrial respiration inhibitors (MRI), electron transport inhibitors (ETI) or inhibitors of respiratory complex III. Being site-specific, they are at risk from the development of resistance in target plant pathogens (Olaya *et al.* 1998) and instances of resistance have been reported overseas.

The Fungicide Resistance Action Committee (FRAC), based in Europe, has indicated that fungicides with strobilurin-type action and resistance (STAR) form a cross-resistance group, which is different to other commercially available fungicides (Anon. 1998). Thus, resistance in fungi to one compound within the STAR group will confer resistance to all STAR compounds, but not to compounds from different cross-resistance groups. Active ingredients of STAR compounds include the strobilurins azoxystrobin, kresoxim-methyl and trifloxystrobin, and the non-strobilurins, famoxadone (oxazolidinone compound) and fenamidone (imidazilinone compound).

This paper describes strategies recommended for the use of STAR compounds in New Zealand to avoid or delay the development of resistance in target plant pathogens. These strategies have been developed under the auspices of the New Zealand Committee on Pesticide Resistance (Elliot *et al.* 1987), and are based on recommendations from the STAR Working Group of FRAC, released in March 1999.

PRODUCT PERSPECTIVE

Products

The range of pathogens against which the various STAR compounds are effective differs with the compound. Different strobilurin products have label claims in New Zealand for use in different crops, and product labels must be consulted. Strobilurins currently registered, or undergoing registration for use in New Zealand, include azoxystrobin, as Amistar and Amistar WG (Crop Care Holdings Ltd), kresoxim-methyl, as Strobby (BASF New Zealand Ltd), and trifloxystrobin as Flint (Novartis New Zealand Ltd). Formulations include suspension concentrate (Amistar) and water dispersible granules (Strobby, Amistar WG, Flint).

Target pathogens and crops

The most important pathogens against which strobilurins are used, or likely to be used, in New Zealand are: *Venturia inaequalis* (apple black spot), *Podosphaera leucotricha* (apple powdery mildew), *Pyrenophora teres* (barley net blotch), *Uncinula necator* (grape powdery mildew), *Plasmopara viticola* (grape downy mildew), *Erysiphe graminis* (cereal powdery mildew), *Puccinia* spp. (cereal rusts), *Septoria* spp. (cereals), *Rhynchosporium secalis* (cereals) and *Alternaria* spp (various crops including cereals, potatoes and tomatoes).

Current and new records of resistance

The first strobilurin was registered in New Zealand in 1997 and there have so far been no recorded instances of resistance to these compounds in this country. Overseas, several instances of field resistance have been noted by FRAC:

1. wheat powdery mildew (*Erysiphe graminis tritici*) from the air spora in Northern Germany in 1998;
2. grape downy mildew (*Plasmopara viticola*) from a trial site in Brazil in 1997;
3. banana black Sigatoka disease (*Mycosphaerella fijiensis*) from a trial site in Costa Rica in 1998;
4. cucurbit powdery mildew (*Sphaerotheca fuliginea*) from commercial crops in Taiwan and Japan in 1998.

STROBILURIN MANAGEMENT STRATEGY

General resistance management guidelines

1. Observe manufacturers' application rate and timing recommendations and the maximum numbers of applications of STAR compounds for specific crops. Reduced rate applications must be avoided.
2. For perennial crops, or where crops are grown successively (e.g. vegetables), alternation programmes, which use fungicides from different cross-resistance groups in conjunction with STAR compounds, should continue between seasons or between crops to ensure numbers of consecutive applications of STAR compounds do not exceed the specified maxima.
3. Apply STAR compounds preventatively, when disease levels are low.

Apples

1. A maximum of 3 applications of STAR containing products per season may be used, either alone or in mixture with an effective dose of a fungicide from a different cross-resistance group.
2. Up to 3 consecutive applications of STAR containing products may be made, with fungicides from a different cross-resistance group used before and after the consecutive STAR applications.
3. Use STAR compounds preventatively and only apply as post-infection sprays against black spot (*V. inaequalis*) where a reliable infection period monitoring system is in place. If repeated post-infection use is required, mix STAR compounds with an effective dose of a curative fungicide from a different cross-resistance group (e.g. DMI or anilopyrimidine).

Grapes

1. A maximum of 3 applications of STAR containing products per season may be used, either alone or in mixture with an effective dose of a fungicide from a different cross-resistance group.

2. Up to 3 consecutive applications of STAR containing products may be made, with fungicides from a different cross-resistance group used before and after the consecutive STAR applications.

Other fruit and vegetable crops

1. STAR compounds should not exceed 33% (1 spray in 3) of the total number of fungicide applications made to each crop.
2. Apply STAR compounds either alone or in mixture with an effective dose of a fungicide from a different cross-resistance group.
3. Up to 3 consecutive applications of STAR containing products may be made, with fungicides from a different cross-resistance group used before and after the consecutive STAR applications.

Cereals

1. A maximum of 2 applications of STAR containing products may be used per cereal crop.
2. Where disease risk is high, apply STAR compounds in mixture with an effective dose of a curative fungicide from a different cross-resistance group.

Implementation

A resistance management statement should be included on all product labels for STAR compounds outlining the risks associated with excessive use and appropriate usage guidelines for specific crops and diseases to avoid resistance.

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