Summaries and recommendations from the 2005 meeting of the Fungicide Resistance Action Committee (FRAC)

Sterol Biosynthesis Inhibitor (SBI) Working Group

Contents

FUNGICIDE RESISTANCE ACTION COMMITTEE

STEROL BIOSYNTHESIS INHIBITOR (SBI) WORKING GROUP

2005 MEETING

Hosting company: BASF AG, Crop Protection Division

Venue of the meeting: DuPont de Nemours, Bad Homburg, Germany

Date: 12th October 2005

Working Group participants present at the meeting

J.-M. Gouot (Chairman), Bayer CropScience SA, Lyon, France
J.L. Genet, DuPont de Nemours (France) SA, Nambsheim, France
D.Hosking, Syngenta, Basel, Switzerland
F. Kerz-Moehlendick, Bayer CropScience, Monheim, Germany
K. Klappach, BASF AG, Crop Protection Division, Limburgerhof, Germany
A. Leadbeater, Syngenta, Basel, Switzerland
A. Mehl, Bayer CropScience, Monheim, Germany
M. Semar, BASF AG, Crop Protection Division, Limburgerhof, Germany
H. Sierotzk, Syngenta, Basel, Switzerland
G. Stammler, BASF AG, Crop Protection Division, Limburgerhof, Germany
K.Stenzel, Bayer CropScience, Monheim, Germany

Excused

O. Puppin, Isagro Ricerca, Milano, Italy

Key Points from meeting

Generally in 2005 a stable situation was found with DMI's and amines.
The guidelines for adherence to recommended use rates were emphasised for cereals.

Wheat

Powdery mildew: stable situation (DMI and amines)
Septoria tritici: After the slight increase in the frequency of less sensitive isolates from 2002 to 2004, the situation has generally stabilised in 2005.
Yellow and brown rust: field performance of DMI's remains good.

Barley

Rhynchosporium: Generally stable situation.
Net blotch: DMI performance unchanged.
Powdery mildew: stable situation (DMI and amines)

Vines

Powdery mildew: performance unchanged (DMI and amines).

Apples

Scab: DMI performance unchanged.
Powdery mildew: DMI performance unchanged.

Fenhexamid (hydroxyanilide) – new SBI class

No change in sensitivity and performance against Botrytis since introduction in 1998.

CEREAL DISEASES

BARLEY

Barley Powdery Mildew (Blumeria graminis f.sp. hordei / Erysiphe graminis f.sp. hordei)

In 2005, disease pressure was generally moderate.

DMIs
Sensitivity data were reported for prothioconazole. The sensitivity of the populations stayed in the range of variation observed in the past seven years.

Amines
Sensitivity data were reported for fenpropidine and spiroxamine . The sensitivity of the populations stayed in the range observed in the previous years. Morpholine products performed well with no farmer complaints.

Scald (Rhynchosporium secalis)

Normal disease infection levels in 2005.Generally stable situation. Sensitivity monitoring data were presented for epoxiconazole (2005), prothioconazole (2004) and tebuconazole (2004): the sensitivity of the populations stayed in the range observed in the previous years.

Net Blotch (Pyrenophora teres /Drechslera teres)

Disease incidence was medium to high in 2005. Sensitivity monitoring data were presented for prothioconazole (2004) .The sensitivity of the populations stayed in the range observed in the previous years. Field disease control was good with no problems reported.

WHEAT

Wheat powdery mildew (Blumeria graminis f.sp. tritici / Erysiphe graminis f.sp. tritici)

Disease pressure was generally medium to high across Europe.

DMIs: Sensitivity data were presented for tebuconazole and prothioconazole, confirming that the situation was generally stable remaining in the range of variability seen over the past 10 years. No complaints from field use. The performance of DMI based products was as expected.

Amines : Sensitivity data were presented for fenpropidin, fenpropimorph and spiroxamine, confirming that the situation was generally stable remaining in the range of variability seen over the past 10 years. Field performance of amine based products was good with no complaints.

Wheat Leaf Spot (Mycosphaerella graminicola / Septoria tritici)
Disease pressure was heterogeneous in Europe in 2005, from moderate to high (North of France). DMI's field performance was generally good . After the slight increase in the frequency of less sensitive isolates from 2002 to 2004, the situation has generally stabilised in 2005.

Wheat Eyespot (Tapesia spp.,, syn. Oculimacula spp.)
Sensitivity data (W and R types) have been presented for prothioconazole. Stable situation has been observed for the last two years.

Rusts (Puccinia recondita and P. striiformis)

Brown rust disease pressure was high in Belgium and UK, low to moderate in the rest of Europe. Yellow rust incidence was high in UK. Performance of DMI's on both brown and yellow rust has been maintained. No sensitivity data were presented.

NON-CEREAL DISEASES

Grape Powdery Mildew (Uncinula necator)

Disease pressure was normal to high in 2005. Performance of DMIs and "amines" was as expected. Spiroxamine monitoring data have been reported for 2004. The sensitivity of the populations stayed in the range observed in the previous years.

Recommendations:

DMI´s should only be used as preventative and not in a curative manner. "Amines" should preferably be used as preventative and not in a curative manner.

The existing strategy for effective disease control and resistance management continues to be successful and the use recommendation is a maximum of 4 applications per season, before symptoms occur. The strategy includes the use of mixtures or alternation with non-cross resistant fungicides.

To ensure that SBI's can remain as the effective basis for Uncinula control in vines, the use of the full-recommended rate (either alone or in mixture), recommended timing, application volume and accurate treatment of each row should be adhered to.

Apple Scab (Venturia inaequalis)

The performance of DMI's was good on this disease in 2005 when compounds were used according to the manufacturers' and FRAC recommendations. Sensitivity data (2005) indicated that no new sensitivity classes have appeared since 1993, although the most sensitive class have disappeared as shown from 2003 compared to 1993.

Recommendations:

DMI fungicides, which are labelled for scab control, are not recommended for season long use and a maximum of 4 DMI sprays either alone or in mixture is recommended.

Where repeated fungicide applications are required, DMI's should be used in mixtures or (block) alternations with a non-cross resistant fungicide. Application of recommended label rates is important.

Preventative applications should always be the first choice with DMI's. Curative applications are only recommended when accurate disease warning systems are available.

Apple Powdery Mildew (Podosphaera leucotricha)

No complaints were received on the performance of DMI's when compounds were used according to the manufacturers' recommendation and FRAC recommendations.
For recommendations see General Recommendations.

Soybean rust (Phakopsora pachyrhizi)
See the FRAC-Brazil website for information (frac@frac-brasil.org.br) when available.
Monitoring methods for baseline establishment and follow-up are being developed.

Banana Sigatoka (Mycosphaerella fijiensis)

The conclusions and guidelines of the Feb. 2004 meeting of the FRAC Banana Working Group are available on the FRAC Website.

Fenhexamid (hydroxyanilides)

Considered a SBI with activity on Botrytis cinerea, which is a high-risk disease. New biochemical mode of action and no cross-resistance with other botryticides. Targets: 4,4-dimethylfecosterol and 4,alpha-dimethylfecosterol in Sterol Biosynthesis pathway (C4 demethylation). Regarded as an inhibitor of C3-ketoreductase.
2005 monitoring studies are in progress

Recommendations for use of Fenhexamid: use fenhexamid only protectively.

Straight product:

Spray schedules with a maximum of 3 treatments per season: max. 1 application with fenhexamid
Spray schedules with 4-5 treatments/season: max. 2 applications with fenhexamid
Spray schedules with 6 and more treatments: at the maximum one third of all Botryticide-applications

Mixtures:

Both partners - if applied alone at the dose used in the mixture - must have sufficient activity against Botrytis. Not more than 50% of all Botryticide-treatments should be made with fenhexamid-containing mixtures.

GENERAL INFORMATION ABOUT SBI's

INTRODUCTION

The FRAC-SBI (formerly DMI) working group was set up in 1982. The group meets annually to review monitoring data and to agree recommendations for the use of SBI fungicides.
The 2005 meeting (hosted by BASF AG, Crop Protection Division, Germany) reviewed the most recent monitoring work undertaken directly by Agrochemical Companies or sponsored by them with academic institutions. Based on a review of these data, statements have been prepared which summarise the most up-to-date knowledge available regarding resistance to SBI fungicides.

DEFINITIONS - SBI-Fungicides

There are three classes of fungicides that comprise the Sterol Biosynthesis Inhibitor's (abbreviated SBI's): the **DMI-fungicides**, the **Amines** (before called "Morpholine"- fungicides) and the **Hydroxyanilides**. All classes inhibit targets within fungal sterol biosynthesis but differ in regard to the precise target sites they inhibit.
The SBI based fungicides represent an important class of agricultural fungicides. They make a major contribution to world agricultural production via their broad spectrum of disease control and excellent field performance.

Class I: DMI-Fungicides

SBI-fungicides that inhibit the C14 demethylation step within fungal sterol biosynthesis are now commonly characterised as **DeMethylation-Inhibitors** (Abbreviation: DMI's).
Chemically, DMI's belong to different classes. Beside triazoles, numerous imidazoles, pyridines and pyrimidine all have been shown to act as demethylation inhibitors.
Typically, DMI's have a broad spectrum of activity against a range of economically important pathogens on arable crops, top fruit, vines, plantation crops, etc.

Class II: Amines or "Morpholine"- Fungicides

Like the DMI's the Amines also belong to different chemical classes. The first representatives of this group were chemically morpholines. Although representatives of two other chemical groups (piperidines and spiroketalamines) have entered the market, the group designation amines are partly used for all three chemical classes. Amines inhibit (to a variable degree) two target sites within the sterol biosynthetic pathway, the $\Delta 8 \rightarrow \Delta 7$ isomerase and the $\Delta 14$ reductase.
Amines have a narrower spectrum of activity than the DMI's. They can be used alone but are often used in mixtures with DMI's to control cereal powdery mildews and rusts.

Class III: Hydroxyanilide -Fungicides

Currently this class is represented by fenhexamid. Hydroxyanilides inhibit the C3-keto-reductase step in ergosterol biosynthesis. Hydroxyanilides have a narrower spectrum of activity than the DMI's and Amines – fenhexamid is a specific botryticide, which does not show cross-resistance to other classes of anti-Botrytis fungicides.

Resistance to fungicides

Resistance to fungicides is a normal phenomenon embodied in the natural process of the evolution of biological systems. By close co-operation within the agrochemical industry and collaboration with researchers, advisors and with growers we can ensure that fungicides are used optimally and continue to offer the benefits they currently confer.

Resistance to SBI fungicides

Resistance to SBI fungicides has been well characterised during the last 20 years. Problems with SBI performance typically became obvious only after several years of intensive use with efficacy degrading stepwise. Following reduced selection pressure, a recovery in sensitivity is often observed.
The mechanism of resistance is mostly controlled by the accumulation of several independent mutations and is generally referred to as “continuous selection”, “quantitative resistance” or “shifting”.

Cross Resistance among SBI-fungicides

Whilst there is positive cross-resistance amongst the DMI's and amongst the Amines, there is no cross-resistance between the DMI's, Amines and Hydroxyanilides

GENERAL RECOMMENDATIONS FOR THE USE OF SBI FUNGICIDES

The SBI fungicides represent one of the most potent classes of fungicides available to the grower for the control of many economically important pathogens. It is in the best interest of all those involved in recommending and using these fungicides that they are utilised in such a way that their effectiveness is maintained.

The summaries and recommendations included in this report are based upon data generated by members of the FRAC-SBI Working Group and upon the work of non-industry collaborators. The working group concentrates its resources on the major crop/pathogen targets from the point of view of resistance risk. Inevitably many, still important, pathogens are omitted. To help in making recommendations for crops and pathogens not directly covered above, the following general recommendations can be made:

Repeated application of SBI fungicides alone should not be used on the same crop in one season against a high-risk pathogen in areas of high disease pressure for that particular pathogen.

For crop/pathogen situations where repeated spray applications (e.g. orchard crops/powdery mildew) are made during the season, alternation (block sprays or in sequence) or mixtures with an effective non cross-resistant fungicide are recommended (see FRAC fungicide group list on the FRAC website).

Where alternation or the use of mixtures is not feasible because of lack of effective or compatible non cross-resistant partner fungicides, then input of SBI's should be reserved for critical parts of the season or crop growth stage.

If DMI's or "amines" performance should decline and sensitivity testing has confirmed the presence of less sensitive forms, SBI's should only be used in mixture or alternation with effective non cross-resistant partner fungicides.

The introduction of new classes of chemistry offers opportunities for more effective resistance management. The use of different modes of action should be maximised for the most effective resistance management strategies.

Users must adhere to the manufacturers’ recommendations. In many cases, reports of “resistance" have, on investigation, been attributed to cutting recommended rates of use, or to poor or miss-timed application.

Fungicide input is only one aspect of crop management. Fungicide use does not replace the need for resistant crop varieties, good agronomic practice, plant hygiene/sanitation, etc.