STEROL BIOSYNTHESIS INHIBITOR (SBI) WORKING GROUP

Minutes from Virtual call on March 3rd, 2021, 11.15: - 12.05, Protocol of the discussions and recommendations of the SBI working group of the Fungicide Resistance Action Committee (FRAC);

Participants of the SBI WG Meetings

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Venue of the annual meeting: Virtual Meeting
Hosting organization: FRAC/Crop Life International

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Anti-Trust Guidelines (from FRAC Constitution) were shown before meetings started.

1. DMI AND AMINES: CEREAL DISEASES

1.1. WHEAT

1.1.1. Septoria Leaf Blotch (*Mycosphaerella graminicola / Zymoseptoria tritici*)

Presentation of monitoring data 2020: ADAMA, BASF, Bayer, Corteva, Sumitomo, Syngenta

- Disease pressure was low to moderate with very dry conditions in some countries in 2020.

- DMIs field performance was good when used according to the manufacturers and FRAC recommendations. No general field resistance has been reported.

- Monitoring 2020 was carried out in Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, France, Germany, , Hungary, Ireland, Italy, Latvia, Lithuania, Netherlands, Norway, Poland, Romania, Russia, Slovakia, , Spain, Sweden, Switzerland, Turkey, Ukraine, and United Kingdom

- After the slight increase in the frequency of less sensitive isolates from 2002 to 2004, the situation had stabilised between 2005 and 2008. In 2009 a trend to slightly higher EC50 values was observed in important cereal growing areas (France, Germany, Ireland, United Kingdom), this trend has slowed down in 2010 to 2012 and was stable in 2013. 2014 sensitivity was in the same range as 2011.

- In 2015 depending on the individual active ingredient and regions slight shifts of sensitivity of populations have been observed. Highest EC50 values were observed in areas of elevated disease pressure and sub-optimal use of azoles in spray programs (e.g. reduction of rates in comparison to the manufacturer's recommended rate and inappropriate use of effective mix-partners).

- In 2016 and also in 2017 the sensitivity of the populations was overall stable on a European level with regional differences also based on different disease epidemics. In regions with lower sensitivity in 2015 the sensitivity of the populations was stable and, in some areas, even partially increased.

- In 2018 the sensitivity of the populations was overall stable on the European level.

- In 2019, the sensitivity of the populations was overall stable on European level with EC_{50} sensitivity values slightly higher compared to 2018 in some geographies but overall in the range of previous years.

- In 2020, the sensitivity of populations was overall stable on European level with EC_{50} sensitivity values in the range of previous years.

- In *Z. tritici*, different DMI haplotypes can lead to varying levels of sensitivity depending on the chemical structure. As DMIs are generally cross-resistant, resistance management approaches should be the same for all DMIs.

- Overall, as already reported in 2019 DMI EC_{50} sensitivity values were somewhat higher in the UK and Ireland than observed on the European continent where a gradient can be observed from North-West to South-East.

In regions with limited options in fungicides classes and/or a common practice of significantly reduced rates DMIs are at higher risk and performance might be impacted.

1.1.2. Powdery mildew (*Blumeria graminis* f.sp. *tritici* / *Erysiphe graminis* f.sp. *tritici*)

Disease pressure in 2020 was low across Europe.

DMIs

Presentation of monitoring data 2020: Bayer, Sumitomo, Syngenta

- DMI field performance was good.

- In 2019, monitoring was carried out in Czech Republic, France, Germany, Poland, and United Kingdom.

- A limited monitoring in New Zealand in 2019 showed sensitivity ranges comparable to European populations.

- In 2020, monitoring was carried out in Belgium, Czech Republic, Denmark, France, Germany, Hungary, Italy, Poland and United Kingdom.

- Sensitivity data presented for 2016 to 2020 confirmed that the situation was overall stable within the range of variability detected during the last 20 years.

- Differences in the sensitivity are significantly a.i. and regionally dependent. Higher resistance factors were observed only for particular DMIs especially in France, Germany and UK, but also to a lesser extend in Belgium.

Amines

Presentation of monitoring data 2020: Bayer, Syngenta

- Field performance of amine-based products was good.

- In 2020 monitoring was carried out in Czech Republic, Denmark, France, Germany, Poland, Slovakia and United Kingdom.

Sensitivity data presented confirmed that the situation in 2020 was stable remaining in the range of variability seen over more than 25 years in monitoring carried out by other FRAC member companies.

1.1.3. Wheat brown rust (*Puccinia triticina*)

Presentation of monitoring data 2020: BASF, Bayer, Sumitomo,

- Brown rust disease pressure was low to moderate in most of the countries in Europe.

- Good field performance of DMIs against rust has been maintained.

- Monitoring in 2020 has been carried out in Belgium, Czech Republic, France, Germany, Hungary, Italy, Poland, Romania, Slovakia, Spain and United Kingdom.

- Sensitivity data from 2020 for wheat brown rust showed that sensitivities were in the range of those of the last 20 years as observed in monitoring from other FRAC member companies

1.1.4. Eyespot (*Tapesia* spp, *syn. Oculimacula* spp.)

Presentation of monitoring data 2020: Syngenta.

- Field performance was good.

- An analysis of samples from France, Germany, Latvia, Lithuania, Poland, Russia, Spain, Ukraine and United Kingdom from 2020 was presented.

- Between 2003 and 2012 there was no change in the sensitivity of W and R types, stable situation had been observed during that time. In 2013, some sensitivity change has been observed in the United Kingdom, but not in France or Germany. In 2014 further sensitivity decrease has been observed in the United Kingdom, and for the first time also in France and Germany. However, overall, resistance factors still remain low and performance was not affected.

- The 2018 data showed a homogenous and sensitive situation in all countries.

- In 2019, still comparable sensitivity ranges and medians were observed in all monitored countries without any geographical variations.

- In 2020, the same range of sensitivity as in previous years was observed in all countries.

1.1.5. Tan spot (*Pyrenophora tritici-repentis, syn. Drechslera tritici-repentis)*

Presentation of monitoring data 2020: Syngenta

- Monitoring data from 2019 in Finland, Lithuania, and United Kingdom showed a narrow range of sensitivity in line with results from previous years.
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- In 2020, a limited monitoring was carried out in Czech Republic, Romania and Sweden. A stable and sensitive situation was observed.

1.1.6. Yellow rust (*Puccinia striiformis*)

Presentation of monitoring data 2020: Sumitomo, Bayer

- Disease pressure was low to moderate.
- In 2020, monitoring was carried out in Belgium, Denmark, France, Germany, Italy, Poland, Portugal, Spain and United Kingdom.

  The first monitoring in 2015 showed high sensitivity and low diversity, and from 2016 to 2020 a stable situation was reported.

1.1.7. Snow Mould (*Microdochium nivale nivale & M. nivale majus/ Monographella spp.)*

Presentation of monitoring data 2020: Bayer, Syngenta

- In 2019, monitoring was carried out in Belgium, France, Germany, Hungary Italy, Sweden Ukraine, and United Kingdom.
- In 2020, monitoring was carried in France & UK.
- In general, a stable sensitivity situation has been reported for the past sevenyears.

1.1.8. Fusarium Head Blight (*Fusarium graminearum*)

No monitoring in 2020

Presentation of monitoring data 2019: Bayer

- Monitoring was carried out in France.
- For the past 10 years, a stable sensitivity situation was observed.

1.1.9. Glume blotch (*Stagnospora nodorum*)

Presentation of monitoring data 2020: Syngenta

- A limited monitoring was carried out in Czech Republic and Sweden. A very narrow sensitivity range with high sensitivity levels was observed.

1.2. BARLEY

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

In 2020, disease pressure was low in Europe.

DMIs

Monitoring was carried out in Czech Republic, Denmark (2016), France, Germany, Latvia, Sweden (2016), Ukraine, and United Kingdom. Results from 2018 & 2020 monitoring in France, Germany and United Kingdom were presented by Bayer.

- DMI products performed well.
- The sensitivity of the populations stayed in the range observed for more than 15 years.

Amines

Presentation of monitoring data 2020: Bayer, Syngenta:

- Monitoring was carried out in France, Germany and United Kingdom.
- Amine products performed well.
- The sensitivity of the populations stayed in the range observed in monitoring programs from other FRAC member companies for more than 20 years

1.2.2. Scald (*Rhynchosporium commune*)

Presentation of monitoring data 2020: BASF, Syngenta

- Field performance of DMIs was good.

- Monitoring was carried out in Denmark, France, Germany, Hungary, IrelandLatvia, Poland,Slovakia, Spain and United Kingdom

- Stable situation. The sensitivity of the populations stayed in the range observed in Europe in the previous 15 years.

1.2.3. Net blotch (*Pyrenophora teres /Drechslera teres*)

Presentation of monitoring data 2020: Bayer, Syngenta

- Disease pressure was generally low in 2019.

- Performance of SBI containing spray programmes was good.

- Monitoring was carried out in Belgium, Czech Republic, Denmark, France, Germany, Hungary, Ireland and United Kingdom.

- In 2017 in France significant shifts of sensitivity of populations have been observed. Highest EC_{50} values were observed in areas of elevated disease pressure, often coupled with a reported reduced variety-resistance at significant cultivation areas, and sub-optimal use of azoles in spray programs (e.g. reduction of rates in comparison to the manufacturer's recommended rate and inappropriate use of effective mix-partners).

- In general, over the past years a significant fluctuation in sensitivity levels between the years was detected. In 2017 in single locations in Germany there have been seen some shifting which needs to be observed in the next season. The monitoring in the other countries showed a stable situation in 2017 within the regular fluctuation.

- The monitoring of the last 20 years showed a certain level of fluctuations of the sensitivity level in the regions over the years. In 2018, the situation stabilized again in all countries including France and Germany, thus being comparable to the long-term monitoring results.

- In 2019, like 2017 lower sensitivities have been frequently detected in major French regions and in a single location in North-Eastern Germany. In the other European regions monitored sensitivity ranges were stable.

- In 2020, monitoring was carried out in Austria, Bulgaria, Czech Republic, Denmark, France, Germany, Hungary, Ireland, Italy, Lithuania, Poland, Romania, Russia, Slovakia, Spain, Sweden, Switzerland, Ukraine and United Kingdom.

- Overall, the sensitivity of populations monitored in 2020 stayed in the range observed in previous years, without any major geographical differences across Europe.

1.2.4. Ramularia leaf spot (*Ramularia collo-cygni*)

Presentation of monitoring data 2020: BASF, Syngenta.

- In 2020, monitoring was carried out in Denmark France, Germany, Hungary, Ireland, Italy, Lithuania, Poland, Slovakia, Spain, Sweden, Switzerland, and United Kingdom.
- Field performance can be regionally significantly affected, due to the low disease pressure hard to evaluate in 2018.
- Isolates were detected showing significant loss of sensitivity. Relevant CYP51-mutations explaining the effects have been identified (I325T, I328L, Y403C/Y405H).
- 2016: broad sensitivity range has been identified with very high frequency of high resistant strains in southern Germany, with moderate frequency in Denmark, Ireland, Belgium, Northwestern Germany, and low frequency detected in France, Austria, Sweden, and United Kingdom. No detection of resistance in Estonia.
- First data from 2016 showed high frequency of resistant strains in Denmark, Ireland, and United Kingdom, moderate frequency in Estonia, low to moderate frequency in Sweden, and no resistant strains were detected in Finland. In other countries the monitoring is still ongoing; the results will be reported later.

In 2018 the results are:

- no isolates with the above-mentioned mutations detected in Switzerland, Spain and Italy, and Sweden.
- no to high frequency in Denmark,
- low to moderate frequency in single samples from Austria, France, Hungary,
- low to high frequency in Germany,
- moderate to high frequency in Belgium, Netherlands, United Kingdom, Ireland, and Latvia.

In 2019 the results are:

- no isolates/samples with the above-mentioned mutations were detected in Spain & Italy
- no to low frequencies in Slovenia and Croatia
- low frequencies of DMI resistance allele were detected in Switzerland and Slovakia

- in Austria, low to moderate frequencies were observed
- moderate to high frequencies in Belgium, Germany and Sweden
- high frequencies in Ireland, United Kingdom and France

In 2020, the results from bioassay and molecular analysis focusing on the most relevant mutations are:

- no to low frequencies of resistance in Italy, Switzerland, and Spain
- no to high frequencies of resistance in France
- moderate to high frequencies of resistance in Germany and Sweden,
- high frequencies of resistance in Czech Republic, Denmark, France, Hungary, Ireland, Lithuania, Slovakia and United Kingdom.

1.2.5 *Puccinia hordei*

Monitoring was carried out in 2014, 2018 and 2019 in Denmark, France, Germany, Sweden, and United Kingdom in 2014, 2018 and 2019 by Bayer

- In this five-year interval, a very stable situation with a narrow range of sensitivity was observed

1.2.6 Smut diseases (*Ustilago* spp.)

Presentation of monitoring data from 2015-2020: Syngenta

- In 2020, monitoring was carried out in Belgium, Czech Republic, Denmark, France, Germany, Hungary, Ireland, Italy, Latvia, Netherlands, Poland, Romania, Slovakia, Spain, Sweden, Switzerland and United Kingdom.
- A few samples showing lower sensitivities to DMIs were monitored between 2015-2020.
- In 2018, from specific locations in the United Kingdom product performance issues were reported. Monitoring results from the UK from 2018 revealed a number of strains with higher EC_{50} values. All UK samples analysed in 2019 & 2020 were in a range of sensitivity comparable to 2016 & 2017.
- A very stable situation with a narrow range of sensitivity was observed in this five-year interval, with exception of a few UK isolates from 2018.

- It should be considered that particular dry and warm climate conditions might negatively affect the performance of products, favouring the disease development in terms of speed and severity.

1.3 SBI – General recommendations for use

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 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, 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.
- Where alternation or the use of mixtures is not feasible because of a 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 the performance of SBIs should decline and sensitivity testing has confirmed the presence of less sensitive isolates, SBIs 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 maximized 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 use rates, or to poorly timed applications.
- 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.
- Exclusive frequency measurements of single cyp51 mutations are not sufficient to describe the sensitivity situation towards DMIs but can help to better understand the background of sensitivity shifts.

1.4 SBI – Recommendations for cereals (DMIs and amines)

The recommendations for the use of DMI and amine fungicides in mixture or alternation programmes with different mode of action fungicides remain unchanged. It needs to be emphasized that it is essential for resistance management purposes to follow strictly the manufacturer's and FRAC recommendations.

Repeated application of DMI or amine fungicides alone should not be used on the same crop in one season against risky pathogens (e.g. cereal powdery mildews, barley net blotch, scald) in areas of high disease pressure for that particular pathogen.

Reduced rates of DMIs can contribute to accelerate the shift to less sensitive populations. It is critical to use effective rates of DMIs in order to ensure robust disease control and effective resistance management. DMIs must provide effective disease control and be used at manufacturers recommended rates.

When used in mixture recommended effective rates of the SBI must be maintained. Split and reduced rate programmes, using multiple repeated applications at dose rates below manufacturer's recommendations, provide continuous selection pressure and accelerate the development of resistant populations, and therefore must not be used.

To ensure good performance and particularly resistance management in situations of even low disease pressure it is essential to adhere to dosages and spray timings as recommended by manufacturers. Curative applications should be avoided. Application timing has to be appropriate to all mix partners' characteristics. Mixing with a non-cross resistant fungicide at effective dose rates contributes to a more effective disease control and resistance management.

The amine fungicides are effective non-cross-resistant partner fungicides for DMIs on cereals for the control of pathogens included in the label recommendation of each respective product.

2. DMI AND AMINES: INDUSTRIAL CROPS

2.1. SOYBEAN

2.1.1. Asian soybean rust (*Phakopsora pachyrhizi*)

Presentation of monitoring data from season 2019/20: Bayer, BASF, Corteva, FMC, Sumitomo, Syngenta,

DMIs

- A sensitivity baseline has been established in Brazil based on 2005/6 data. Extensive monitoring was carried out since 2007/8 across the country.
- Sensitivity shifts have been observed with a trend to stabilize in season 2010/11. This has to be seen in connection with the recommendation of an azole use in mixtures only and the introduction of a crop-free period. This trend continued in the following seasons until season 2013/14. In 2014/2015 slight shifts in sensitivity has been observed compared to 2013/14. In 2015/16 and 2016/17 the sensitivity level was on the same level as in previous years.
- In 2017/18 monitoring showed in general a stable situation as in the last years, but locally some slight shift was observable in western parts of Brazil.
- Despite this situation it is recognized that a regional variability in performance of DMI mixtures has been observed.
- In 2018/19, in some Brazilian regions a tendency towards lower sensitivities with higher variability was observed. In other regions, the sensitivity of populations was stable compared to previous years.
- In 2019/20, across tested Brazilian and Paraguayan regions the observed sensitivity levels were on the same level as in previous years.

SBI – Recommendations for Asian soybean rust:

Refer to the general recommendations for SBI's.

In addition, to ensure robust disease control and resistance management it is essential to

- Apply DMI fungicides always in mixtures with effective non-cross resistant fungicides (mix partner shall provide control over the spraying interval).
- Refer to manufacturers recommendations for rates. Reduced rates must be avoided.
- Apply preventively or as early as possible in the disease cycle.
- Ensure a proper coverage of the treated crop by appropriate and well calibrated application technology (e.g. to ensure penetration into canopy).

- Apply DMI fungicide containing products always at intervals recommended by the manufacturers and adjusted to the disease epidemics. Avoid extended spray intervals.
- Good agricultural practices must be considered to reduce source of inoculum, disease pressure and resistance risk, e.g. no multiple cropping, implement and respect soybean-free periods, consider partially resistant soybean varieties, reduce the planting window, give preference to early-cycle varieties and endorse the destruction of volunteers.

2.1.2. Target Spot (*Corynespora cassiicola*)

DMIs

- First studies were carried out with isolates from season 2013/14 and 2014/15 by BASF. These initial studies showed high sensitivity to DMIs.
- Monitoring analysis from season 2016/17 and 2017/18 was presented by Syngenta. A stable sensitive situation was observed.
- In 2018/19, monitoring was carried out by BASF and Syngenta. A stable sensitivity situation was observed in comparison to previous years.
- In season 2019/20, monitoring was carried out by BASF and Syngenta. A stable sensitivity situation was observed in comparison to previous years.

2.1.3. Cercospora leaf blight spp. (*Cercospora spp.*)

DMIs

- In season 2019/20, an initial monitoring was carried out by Syngenta. Data showed high level of sensitivity across sampled regions in Brazil.

2.2. OILSEED RAPE

2.2.1. Phoma leaf spot and stem canker, blackleg (*Leptosphaeria maculans / L. biglobosa*)

Presentation of monitoring data in 2020: BASF, Syngenta

- In 2018/19, monitoring was carried out in Czech Republic, France, Finland, Germany, Hungary, Poland, Romania, Slovakia, and United Kingdom. Data showed a stable sensitivity range as in the last 10 years.

- In 2019/2020, monitoring was carried out in, Czech Republic, Finland France, Germany, Hungary, Ireland, Latvia, Lithuania, Poland, Romania, Slovakia, Sweden and United Kingdom.
- Monitoring data showed a stable sensitivity range as in previous years.

- For recommendations see General Recommendations.

2.2.2. Sclerotinia stem rot, white mould (*Sclerotinia sclerotiorum*)

Presentation of monitoring data for 2016: BASF, Bayer, Syngenta; for 2017: Bayer, BASF, Syngenta; for 2018: BASF, Bayer, Syngenta, for 2019: Bayer, BASF, Syngenta; for 2020: Syngenta

- Monitoring was carried out in 2016 in Czech Republic, France, Germany, Lithuania, Poland, Slovakia, and United Kingdom. Disease pressure was low to moderate.

- Monitoring was carried out in 2017 in Czech Republic, Denmark, France, Germany, Latvia, Lithuania, Poland, Sweden, and United Kingdom. Disease pressure was low to moderate.

- Monitoring was carried out in 2018 in Bulgaria, Czech Republic, France, Germany, Hungary, Poland, Romania, Slovakia, and United Kingdom. Disease pressure was low to moderate.

- Monitoring was carried out in 2019 in Bulgaria, Czech Republic, Denmark, France, Germany, Hungary, Latvia, Poland, Romania, Slovakia and Ukraine. Disease pressure was moderate.

- In 2020, monitoring was carried out in Bulgaria, Czech Republic, Denmark, France, Germany, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Ukraine and United Kingdom.

- Monitoring data from the five years showed a stable and narrow sensitivity range with no geographical differences.

- For recommendations see General Recommendations.

2.3. SUGAR BEET

2.3.1. Leaf spot (*Cercospora beticola*)

Presentation of monitoring data for 2018 and 2019: BASF, Bayer, Syngenta (DMI & Amines); for 2020: Syngenta

Monitoring 2020 is still ongoing at Bayer & BASF,

DMIs

- Monitoring in 2017 was carried out in Austria, Czech Republic, France, Germany, Greece, Lithuania, Netherlands, Poland, Romania, Russia, Slovakia, Serbia, and United Kingdom. A stable situation was observed as in the last 5 years.

- Monitoring in 2018 was carried out in Austria, Belgium, Czech Republic, Denmark, France, Germany, Hungary, Italy, Lithuania, Poland, Romania, Russia, Slovakia, Spain, Switzerland, the Netherlands, Turkey, Ukraine, and United Kingdom. A stable sensitivity situation was observed as in the last 6 years.

  Monitoring in 2019 was carried out in Austria, Belgium, France, Germany, Italy, Poland, Romania, Slovakia, Spain, Switzerland and The Netherlands. A stable sensitivity situation was observed as in previous years.
- Single isolates with increased EC_{50} values were already detected in France and Germany in previous years but remain stable at a low frequency.

- In 2020, monitoring was carried out in Belgium, Czech Republic, Denmark, France, Germany, Hungary, Italy, Lithuania, Poland, Romania, Spain, Switzerland & the Netherlands. Overall, a stable sensitivity situation was observed as in previous years.

Field performance can be affected when solo DMI's are used

The broad range of sensitivity leads to the assumption that a shift took place before routine monitoring was set up.

Amines

- Monitoring in 2017 was carried out in Austria, Czech Republic, France, Germany, Greece, Lithuania, Netherlands, Poland, Romania, Russia, Slovakia, Serbia, and United Kingdom.

- Monitoring in 2018 was carried out in Austria, Belgium, Czech Republic, Denmark, France, Germany, Hungary, Italy, Lithuania, Poland, Romania, Russia, Slovakia, Spain, Switzerland, the Netherlands, Ukraine, and United Kingdom.

- Monitoring in 2019 was carried out in Austria, Belgium, France, Germany, Italy, Poland, Romania, Slovakia, Spain, Switzerland and The Netherlands. The monitoring revealed a stable situation with a small range of sensitivity and without geographic variations.

- In 2020, monitoring was carried out in Belgium, Czech Republic, Denmark, France, Germany, Hungary, Italy, Lithuania, Poland, Romania, Spain, Switzerland & the Netherlands. The monitoring revealed a stable situation with a small range of sensitivity and without geographic variations.

- For recommendations see General Recommendations.

2.4 RICE

2.4.1. Narrow brown spot (*Cercospora oryzae*)

Initial sensitivity studies performed 2017 by Syngenta with limited number of strains indicated high and homogenous sensitivity in Indonesia.

2.4.2 *Rhizoctonia solani*

Monitoring was carried out in China by Syngenta in 2015, 2016 and 2017. The monitoring indicated a stable and sensitive situation.

2.5 COTTON

2.5.1. Ramularia leaf blight *(Ramularia gossypii, R. areola; Mycosphaerella areola)*

DMIs

Monitoring carried out 2017 by Syngenta in Brazil.
The data showed sensitivity within the known baseline generated in 2011.

In 2018, monitoring was carried out by Syngenta in Brazil. The observed sensitivity range is comparable to the results from 2011. Single isolates with higher EC_{50} values were detected in 2018.

Amines

In 2018 and 2019, monitoring was carried out by BASF in Brazil. The results showed a sensitive situation with EC_{50} values being in a similar range over the two years.

2.5.2. Target spot (*Corynespora cassiicola*)

DMIs

In 2018, BASF and Syngenta performed a monitoring in Brazil. The results showed a sensitive situation with a narrow range of sensitivity.

In 2019, monitoring was carried out by BASF in Brazil. The results showed a sensitive situation with EC_{50} value being in a similar range over the two years.

2.6 Sunflower

2.6.1 Sclerotinia stem rot (*Sclerotinia sclerotiorum*)

DMIs

In 2019, initial monitoring was carried in Slovakia, Romania, Bulgaria by BASF. Data showed a narrow sensitivity range with EC_{50} values comparable to *S. sclerotiorum* in oilseed rape.

3. DMI AND AMINES: OTHER CROPS

3.1. GRAPE VINE:

3.1.1 Powdery mildew (*Erysiphe necator*)

Monitoring data for **DMIs** were presented by Bayer (2017,2018), Corteva (2017, 2018, 2019), and Syngenta (2017, 2018, 2019, 2020).

- Disease pressure was moderate across Europe in 2017 & 2019, low in 2018.
- Monitoring was carried out in 2017 in Austria, Croatia, Czech Republic, France, Germany, Hungary, Italy, Portugal, Romania, Slovakia, Spain, Switzerland, and Turkey.
- Monitoring was carried out in 2018 in Austria, Croatia, Czech Republic, France, Germany, Greece, Hungary, Italy, Romania, Slovenia, Spain, and Switzerland.
- Monitoring was carried out in 2019 in Austria, Bulgaria, Croatia, Czech Republic, France, Germany, Hungary, Italy, Portugal, Slovenia, Spain, and Switzerland
- In 2020, monitoring was carried out in Croatia, France, Germany, Italy, Portugal, Slovenia and Spain.
- since 2017, sensitivity for DMIs in Europe is stable and generally in the normal range of fluctuation.

Generally, population sensitivity can vary significantly between locations and years within individual countries. Exclusive frequency measurements of single *cyp51* mutations are not sufficient to describe the sensitivity situation in *Erysiphe necator* populations towards DMIs.

Monitoring data for **amines** for 2019 & 2020 were presented by Bayer:

- In 2019, monitoring was carried out in Austria, Croatia, Germany, Italy, Portugal, and Spain. In 2020, monitoring was carried out in Austria, France, Germany, Hungary, Italy, Spain and Switzerland.

- Stable situation in the European countries with low resistance factors towards amines with only small regional fluctuations close to the baseline.

SBI – Recommendations for Grape Vine:

- DMI´s and amines should be used preventative and curative situations should be avoided.
- 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 per mode of action. The strategy includes the use of mixtures or alternation with non-cross resistant fungicides.
- To ensure that SBI's can remain the effective basis for control of *Erysiphe necator* in grape vine, their use should adhere to the full recommended rate (either alone or in mixture) at the recommended timing and application volume and an accurate treatment of each row.

3.2. STONE AND POME FRUIT

3.2.1. Scab on APPLE (*Venturia inaequalis*)

Presentation of monitoring data by Bayer (2017, 2018) and Syngenta (2017, 2018, 2019, 2020)

- Disease pressure in 2019 was low to moderate and disease onset started late in the season across Europe.
- The performance of DMIs was good on this disease when compounds were used according to the manufacturers' and FRAC recommendations within spraying programmes.
- In 2018, monitoring was carried out in Belgium, Croatia, France, Germany, Greece, Hungary, Italy, the Netherlands, Poland, Spain, and Switzerland.
- In 2019, monitoring was carried out in Austria, Bulgaria, Croatia, France, Germany, Hungary, Latvia, the Netherlands, Poland, Slovenia, and Spain.

- In 2020, monitoring was carried out in Belgium, Croatia, France, Germany, Hungary, Italy, Netherlands, Poland, Portugal, Slovenia, Spain and Switzerland.

Overall, the sensitivity in European populations remains unchanged since around a decade. A few outliers with lower sensitivity levels were observed.

SBI – Recommendations in Pome- and Stonefruit:

- DMI fungicides are not recommended for season long use and a maximum of 4 DMI sprays either alone or in mixture is recommended.
- DMIs 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 DMIs. Curative applications are only recommended when accurate disease warning systems are available.

3.2.2. Powdery mildew (*Podosphaera leucotricha*) on APPLE

Presentation of monitoring data for 2017,2018 & 2020: Syngenta

- Performance of DMI was good.
- In 2017, monitoring was carried out in Belgium, Croatia, France, Hungary, Italy, and Poland.
- In 2018, monitoring was carried out in Belgium, Croatia, Hungary and Italy.
- In 2020, monitoring was carried out in Croatia, France, Italy, Poland, Portugal, Slovenia and Spain. Monitoring was started across Europe in 2010. No change in sensitivity comparing 2020 to 2010 was observed.
- See General Recommendations.

3.2.3. Brown rot on stonefruit (*Monilinia* spp.) – ALMOND, APRICOT, CHERRY, NECTARINE, PEACH, PLUM

Presentation of monitoring data by Syngenta (2018,2019 & 2020).

- In 2018 & 2019, monitoring was carried out in Belgium, Bulgaria, Croatia, France, Germany, Hungary, Italy, Poland, and Spain.

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- In 2020, monitoring was carried out in Greece, France, Hungary and Spain. Crops sampled were almond, nectarine and cherry.

- A narrow and homogenous distribution of sensitivity was detected across all crops, countries and species.

3.2.4. *Stemphylium vesicarium* on PEARS

Presentation of monitoring data by Syngenta (2018 -2020)

- In 2018, monitoring was carried out in Belgium, Italy, Portugal, and Spain.

- In 2019, monitoring was carried out in Hungary, The Netherlands, Portugal and Spain.

- In 2020, monitoring was carried out in Belgium, Italy, Portugal & Spain.

- Overall, a homogenous and stable situation in terms of sensitivity was observed.

3.3. TOMATO / POTATO

3.3.1. *Alternaria solani*, *Alternaria alternata* and *Alternaria tomatophila*

Presentation of monitoring data for 2020: Syngenta.

Monitoring 2020 is still ongoing.

- In 2020, monitoring was carried out on potatoes and/or tomatoes in, Belgium, Bulgaria, Croatia, Denmark, France, Germany, Hungary, Italy, , Poland and Serbia,

- *A. alternata* and *A. solani* on potato: all strains collected in 2019 are in the same range of sensitivity as in the previous 6 years.

- Monitoring was carried out on tomatoes in Croatia, Italy, Portugal, Poland, and Spain.

- *A. alternata* and *A. solani* on tomato: all strains collected in 2019 are in the same range of sensitivity as in the previous 5-6 years.

- In 2020, a homogenous sensitivity of both pathogens was observed comparable to previous years.

- *A. tomatophila* on tomato: initial sensitivity studies performed in 2018 by Syngenta with limited number of strains indicated high and homogenous sensitivity in USA.

3.3.2. *Oidium neolycopersici*

Monitoring was carried out by Syngenta since 2015.

- Monitoring in 2018 showed a comparable sensitivity range as monitored since 2015, with no variations between countries.

3.3.3. Leaf mold (*Cladosporium fulvum)*

Presentation of monitoring data 2019: Syngenta

- In 2019, monitoring was carried out in China.
- Initial studies performed in 2019 indicated a high and homogenous sensitivity.

3.3.4. Silver scurf (*Helminthosporium solani*)

Presentation of monitoring data 2020: Syngenta

- In 2020, potato crops grown in Germany, Hungary, Italy, Latvia, Lithuania, Netherlands, Romania, Spain and United Kingdom were monitored.
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- A stable sensitivity range was observed in European countries since 2012. In 2019 and 2020, a few isolates showed slightly lower sensitivity levels.

3.4. CUCURBITS

3.4.1. *Podosphaera xanthii/Sphaerotheca fuliginea*

Presentation of monitoring data for 2018,2019 & 2020: Syngenta

Monitoring 2020 is still ongoing.

- In 2018, monitoring was carried out in Belgium, France, Italy, Netherlands, Poland and Spain.

- In 2019, monitoring was carried out in France, Greece, Italy, and Spain.

- In 2020, monitoring was carried out in Belgium, Bulgaria, France, Hungary, Greece, Italy, Poland, Serbia and Spain. Crops sampled were cucumber, melon and zucchini.

- No change of sensitivity has been observed from 2011 to 2020, and no variations between countries and samples collected from cucumbers, melon, watermelon, pumpkin, squash or zucchini were monitored.

3.4.2. Gummy Stem blight (*Didymella bryoniae*)

Presentation of monitoring data 2019: Syngenta

- Monitoring started in 2017 and continued in 2018 & 2019 in the countries Belgium and Spain

- Narrow sensitivity ranges were monitored in 2019 comparable with a sensitive population

3.5. OTHER VEGETABLES

3.5.1. *Alternaria* species on BROCCOLI, CABBAGE, CARROTS, CAULIFLOWER

Several crops and species were analysed in 2017 for the first time by Syngenta.

Presentation of monitoring data 2018,2019: Syngenta

- In 2019, monitoring was carried out in Belgium, Croatia, France, Greece, Hungary, Italy, Poland, Portugal, and Spain.

- Monitored species were *Alternaria alternata*, *A. brassicae, A. brassicicola, and A. dauci* on broccoli, cabbage, and carrots.

- There is no indication of a decreased sensitivity across all crops, countries, and species.

3.5.2. *Stemphylium vesicarium* on ASPARAGUS

Monitoring was carried out in the United Kingdom in 2018 by Syngenta.

- Stable sensitivity as in the previous years, single isolates with higher ED50 values were already detected, but remained stable at a low frequency.

3.5.3. *Stemphylium botryosum* on SPINACH

Initial sensitivity studies performed in 2018 by Syngenta with limited number of strains indicated high and homogenous sensitivity in the USA.

3.5.4. White mould (*Sclerotinia sclerotiorum*) on BEANS

Presentation of monitoring data in 2020: Syngenta

- In 2020, for the first time monitoring on beans and green beans was carried out in France.
- All isolates collected showed a narrow sensitivity range and high sensitivity (low EC50 values).

3.5.5. White mould (*Sclerotinia sclerotiorum*) on LETTUCE

Presentation of monitoring data in 2020: Syngenta

- In 2020, for the first time monitoring on lettuce was carried out in Spain.
- All isolates collected showed a narrow sensitivity range and high sensitivity (low EC50 values).

3.6. CITRUS, STRAWBERRY

3.6.1. Anthracnose (*Colletotrichum acutatum*)

Initial sensitivity studies performed 2017 by Syngenta with limited number of strains indicated high and homogenous sensitivity in USA.

3.7. BANANA

3.7.1. Black Sigatoka (*Mycosphaerella fijiensis*)

The conclusions and guidelines of the April 2018 meeting of the FRAC Banana Working Group are available on the FRAC Website (http://www.frac.info/frac/index.htm). The next meeting of the group is planned in 2020.

4. SBI-CLASS III (KETO-REDUCTASE-INHIBITORS – KRI)

This group comprises of Fenhexamid and Fenpyrazamine as inhibitors of the Keto-Reductase (KRI). Both are cross-resistant.

4.1. Grey mould (*Botrytis cinerea*) on GRAPE VINE

Presentation of monitoring data: Bayer (2014 - 2018), and Sumitomo (2016, 2017, 2018, 2019).

- Disease pressure was moderate across Europe in 2017.
- Monitoring was carried out in Austria, Chile, France, Germany, Italy, and Spain
- High frequencies of resistant isolates were detected in Chile (2014, 2015, 2016).
- In 2016, moderate to high frequencies in Germany, low frequencies in France and very low frequencies in Italy and Spain.
- In 2017, the frequency of resistant isolates was low in Austria and France, moderate in Germany, and in Italy all strains analysed were fully sensitive.
- In 2018, the frequency of resistant isolates was very low in Hungary and Italy, low in France, moderate in Germany, and moderate to high in Chile
- In 2019, monitoring was carried out in Austria, France, Germany, Hungary, Italy and Spain. The frequency of resistant isolates was low in Austria, Hungary and Spain, low to moderate in France & Germany, and moderate in Italy.

Field performance of botryticides is most effective if embedded in sound spray programmes respecting the individual resistance management recommendations.

4.2. Grey mould (*Botrytis cinerea*) on STRAWBERRIES

Presentation of monitoring data: Bayer (2017, 2018, 2019, 2020), and Sumitomo (2017, 2018, 2019).

- In 2017, monitoring was carried out in 2017 in Denmark, France, Germany, Netherlands, Poland, and United Kingdom.

  High presence of resistant strains was observed in United Kingdom, low to moderate presence in Denmark, Germany, and Netherlands, low presence in Austria, France, and Poland.

- In 2018, monitoring was carried out in Austria, Denmark, France, Germany, Italy, Netherlands, Norway, Poland, Sweden, Spain and the United Kingdom.The frequency of resistant isolates was low in Austria, France, Poland and Sweden, low to moderate in Denmark, Italy, the Netherlands and Germany, moderate in Spain, and moderate to high in Norway and the United Kingdom.

- In 2019, monitoring was carried out in Austria, France, Denmark, Italy, Poland, Germany, and United Kingdom

- The frequency of resistant isolates was low in Austria, France and Denmark, low to moderate in Poland, moderate in Germany, moderate to high in Italy and the United Kingdom in 2019.

- In 2020, monitoring was carried out in France, Germany, Italy, Norway, Poland and United Kingdom. The frequency of resistant isolates was low to moderate in France, Germany, Italy, Norway and Poland, and moderate in United Kingdom.

4.3. Grey mould (*Botrytis cinerea*) on RASPBERRIES

- No monitoring for 2016 and 2017 and 2018.

- Presentation of monitoring data for 2014 and 2015: Bayer

- Limited monitoring in Norway in 2014 showed high frequency of resistant strains.

- Monitoring in 2015 in the Netherlands showed moderate frequency of resistance.

4.4. Grey mould *(Botrytis cinerea)* on TOMATO

Presentation of monitoring data from 2017, 2018 & 2020: Sumitomo

- In previous years, monitoring was carried out in France, Hungary, Italy, the Netherlands, Poland and Spain

- Frequency of resistant isolates in Spain was low. In all other countries, no resistant isolates were detected
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- In 2019, monitoring was carried out in France, Hungary and Italy. The frequency of resistant isolates was low in France and Hungary, and moderate in Italy.

4.5. KRI – Recommendations for control of Botrytis spp.:

- Use KRIs only protectively.
- Use KRIs only in strict alternation, no block application
- Solo product as part of alternation programmes:
    - Spray programmes with a maximum of 3 treatments per season: max. 1 application with KRIs
    - Spray programmes with 4-5 treatments/season: max. 2 applications with KRIs
    - Spray programmes with 6 and more treatments: at the maximum one third of all Botryticide-applications
- Use in 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 KRIs-containing mixtures.

For sound resistance management, good agricultural practices, including phytosanitary measures and crop protection, should be followed carefully.

5. NEXT MEETINGS

Next virtual call is planned for June 23rd, 2021.
Next annual WG meeting is planned for January 21st, 2022.