Quinone 'outside' inhibitor (QoI) Working Group

Meeting on 25th of March 2026, 13:30 to 17:00 and 26th March 8:30 to 12:00
Update meeting on 30th of September 2026
Protocol of the discussions and use recommendations of the QoI Working Group of the Fungicide Resistance Action Committee (FRAC)

Participants (to be updated)

Helge Sierotzki (Chair)	Syngenta
Gerd Stammler	BASF SE
Michael Merck	BASF
Raffaello Zito	BASF SE
Andreas Mehl	Bayer
Chris Cooksley	Bayer (arable crops)
Mamadou Mboup	Corteva
Andy Leader	Corteva
Amandine Picard	Corteva
Gaelle Huet	FMC
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Yasuhiro Fukami	Nissan Chemical Corporation
Hiroyuki Ito	Nissan Chemical Europe
Yuichi Matsuzaki	Sumitomo
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Companies participating in the meeting: BASF, Bayer, FMC, Corteva, Syngenta, Sumitomo, ISK, Nissan

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1. Introduction

The working group is responsible for global fungicide resistance strategies in the Qo inhibitor fungicides (QoI). The Qo inhibitor fungicides (QoI) all act at the Quinone 'outer' (Qo) binding site of the cytochrome bc1 complex, separated into two subgroups reflecting different binding properties (FRAC codes 11 and 11A)

The QoI FRAC code 11 fungicides are: azoxystrobin, bifemetstrobin, coumoxystrobin, dimoxystrobin, enoxastrobin, famoxadone, fenamidone, fenaminostrobin, fluoxastrobin, flufenoxystrobin, kresoxim-methyl, mandestrobin, metominostrobin, orysastrobin, pyraoxystrobin, picoxystrobin, pyraclostrobin, pyrametostrobin, pyribencarb, triclopyricarb, trifloxystrobin

QoI FRAC code 11A fungicide is: metyltetraprole

Fungicides within each code group are all cross-resistance to each other and should be managed accordingly. Fungicides in the code group 11A are not cross resistant to fungicides in the FRAC code group 11 based on the G143A mutation.

2. Minutes of discussions

2.1. Review of sensitivity monitoring

In the text below the categorisation of the findings ranging from "high" to "no resistance" are based on agreed frequency of resistant or adapted isolates in collections of samples from the respective countries or regions mentioned (no, no to low, low, low to medium, medium, medium to high, high, low to high, no to high resistance). Please refer to the wording in each category for more specific information.

The current minutes focus on the most recent available information. Additional information is given in previous minutes.

Fungicides in FRAC code 11:

2.1.1. Cereal diseases

Field experience in 2025 has confirmed that, when used according to FRAC guidelines, the performance of QoI containing products within spray programmes was good. QoIs continue to contribute to overall disease management in cereals.

Powdery mildew (*Blumeria graminis* f. sp. *tritici* = *Erysiphe graminis* f.sp. *tritici*), wheat and rye (*Blumeria graminis f. sp secalis*)

Companies: BASF

In 2024, monitoring showed high frequency of resistance in Denmark, Estonia, Latvia, Lithuania, and Sweden. Moderate levels were found in Bulgaria, Czech Republic, Romania and Slovakia.

Findings in 2021:
Data based on molecular studies indicate moderate to high frequency of G143A in France, Germany, Latvia and Poland, moderate in Estonia and Lithuania and low in Hungary in 2021.

Septoria leaf spot (*Septoria tritici* = *Mycosphaerella graminicola* = *Zymoseptoria tritici*), wheat

Companies: BASF, Syngenta

In 2025 monitoring has been carried out in Austria, Czechia, France, Germany, Estonia, Lithuania, Ireland, Poland and United Kingdom.
Based on molecular studies, high frequency of resistance has been detected in all monitored countries.

In 2024 based on molecular studies high frequency of resistance has been detected in Belgium, Croatia, France, Germany, Hungary, Ireland, Italy, Netherlands, Poland. Spain, Switzerland and United Kingdom. Heterogeneous situation ranking from no to high in Bulgaria (limited sampling) and moderate to high levels were found in Austria (limited sampling).

Monitoring data based on molecular data showed in 2023 the following situation:
In Austria, Belgium, Croatia, Czech Republic, Denmark, France, Germany, Greece, Ireland, Netherlands, Poland, Sweden and United Kingdom widespread resistance was detected at high levels in all these countries.
Moderate frequency of resistance was detected in Italy, Switzerland, Romania
Low levels of resistance were reported in Bulgaria, Hungary, Slovakia and Russia.

Brown rust *(Puccinia triticina*), wheat

Companies: BASF, Bayer and Syngenta

Monitoring based on molecular methods has been carried out in 2025 in Austria, Belgium, Bulgaria, Czechia, Denmark, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Romania, Slovakia, Spain, Sweden and United Kingdom.
Extensive monitoring showed full sensitivity in 2025.

In 2024, extensive monitoring in Austria, Bulgaria, Denmark, France, Germany, Hungary, Ireland, Italy, Netherlands, Poland, Romania, Sweden and United Kingdom showed full sensitivity.

The monitoring in 2023 based on bioassay and molecular studies confirmed a full sensitive situation as reported already since introduction of this mode of action.
Countries tested in 2023 included Belgium, Bulgaria, Czech Republic, France, Germany, Hungary, Italy, Poland, Romania and United Kingdom.

Additional information: These findings are consistent with the reported presence of a lethal intron in several fungi making the G143A mutation unlikely to occur (see FRAC QoI Intron Document).

Yellow rust (*Puccinia striiformis*), wheat

Companies: Bayer and Syngenta

In 2025 monitoring has been carried out in Denmark, France, Germany, Netherlands, Poland, Spain, Sweden and United Kingdom.
Extensive monitoring showed full sensitivity in 2025.

In 2024, monitoring revealed full sensitivity based on bioassay in Bulgaria, Croatia, Denmark, France, Germany, Netherlands, Poland, Spain and United Kingdom.

The monitoring in 2023 based on bioassay confirmed a fully sensitive situation as reported already since introduction of this mode of action.
Countries tested in 2023 included, Bulgaria, Croatia, Czech Republic, France, Germany, Hungary, Netherlands, Poland, Romania, Slovakia, Spain and United Kingdom.

Brown rust on Rye (*Puccinia recondita f. sp. secalis*)

Companies Syngenta

Monitoring based on bioassay has been carried out in 2025 in Czechia, Germany, Poland Slovakia and United Kingdom.
Monitoring showed full sensitivity.

***Rhizoctonia solani*, wheat**

Companies: Syngenta

In 2020 limited monitoring data based on bioassay showed full sensitivity in Germany and Spain.

Tan spot (*Pyrenophora tritici-repentis*), wheat

Companies: BASF, Syngenta

Monitoring based on molecular methods in 2025 in Bulgaria Czechia, Estonia, Finland, Germany, Hungary, Latvia, Lithuania, Poland, Slovakia, Romania, Russia and Sweden. In all samples high frequency of G143A mutation has been detected, except for Bulgaria with some samples without any mutation.

In 2024, monitoring based on molecular studies in Latvia, Lithuania, Estonia, Finland, Sweden, Germany, Hungary, and Romania showed high frequency of the mutation G143A.

Monitoring in 2023 based on molecular studies measuring frequency of G143A, F129L showed the following situation.
Low to high levels of G143A mutation were detected in Poland and Sweden.
High levels were detected in Estonia and Lithuania.
The F129L mutation was not detected anymore.

Additional information: Although all three point mutations known for QoIs (G143A, F129L, G137R) have been detected in the past, and can occur in the same population, the G143A mutation is now dominant in this pathogen.

Eyespot *(Oculimacula* spp*)*

Companies : BASF

In 2023, monitoring in Czech Republic, Germany, Poland, Latvia, Lithuania, Romania and United Kingdom showed a broad range of sensitivity based on bioassay but considered as sensitive.

Monitoring based on bioassay in 2020 showed full sensitivity in German, Latvia, Lithuania, Poland Romania and United Kingdom.

Snow mold *(Microdochium nivale)*

Companies: Syngenta

In 2024, limited monitoring confirmed high frequency of resistance in Germany and Italy as known from past monitoring.

Powdery mildew (*Blumeria graminis* f. sp. *hordei* = *Erysiphe graminis* f.sp. *hordei*), barley

No monitoring since 2020.

Net blotch (*Pyrenophora teres*), barley

Companies: BASF, Bayer, Syngenta

Monitoring based on molecular methods has been carried out in 2025 in Belgium, Bulgaria, Czechia, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Netherlands, Poland, Romania, Slovakia, Sweden, Ukraine and United Kingdom.
High frequency of F129L mutation was detected in Estonia, France, Germany, Hungary, Ireland, Latvia, Lithuania, Poland and United Kingdom,
Moderate levels were shown in Czechia, Italy, Netherlands, Spain, Sweden and Ukraine,
Low level was reported in Bulgaria, Finland, Romania and Slovakia.

Additional information: Mainly the F129L mutation was found. As already observed with other pathogens, resistance factors are significantly lower in comparison with the G143A mutation and field performance of products used according to FRAC and Manufacturers' recommendations remains good (for differences between QoI mutations see also the respective FRAC document titled "Mutations associated with QoI resistance" available on the FRAC website under QoI fungicides →Quick references).

In 2024, frequency of F129L showed following situation:
High frequency was detected in Germany, Ireland, Latvia and Poland.
Heterogenous situation, from no to high, was found in France and Italy
Moderate levels were shown in Denmark, Hungary, Lithuania, Netherlands, Spain, Sweden, Ukraine and United Kingdom
Low was reported in Bulgaria, Croatia, Czech Republic, Romania and Slovakia

Monitoring in 2023 based on bioassay and molecular studies showed the following situation:
Moderate to high levels of F129L mutation were found in Denmark, France (heterogenous), Germany, Ireland, Slovakia, Sweden and United Kingdom.
Moderate levels of F129L mutation were detected in Italy, Lithuania, Netherlands, Poland and Spain.
Low levels of F129L mutation were reported in Bulgaria, Czech Republic, Hungary, Romania and Ukraine.
No resistance or mutation were found in Greece and Russia

However, in 2023 and 2024 few single strains with high resistance factor, indicating presence of G143A, was found in Denmark, Finland, Lithuania or Sweden. Similar observation has been made already in 2019 in a single strain from Denmark. Probably this is based on partial mitochondrial cyt b gene transfer from Pyrenophora tritici-repentis to Pyrenophora teres. (Journal of Plant Diseases and Protection https://doi.org/10.1007/s41348-022-00631-6).

Leaf scald (*Rhynchosporium secalis* = *Rhynchosporium commune*), barley

Companies: BASF, Bayer and Syngenta

In 2024, monitoring based on bioassay and molecular studies in Czech Republic, France, Germany, Ireland, Romania, Slovakia and Spain showed full sensitivity.

Limited monitoring program in 2023 in Germany showed full sensitivity situation.

Additional information: However, in some years since 2008 (e. g., 2012, 2013 France, 2014 UK, 2015 Spain, 2019 United Kingdom), occasionally isolates/samples have been found containing the G143A mutation. The frequency is always very low.

Ramularia leaf spot *(Ramularia collo-cygni)*, barley

Companies: BASF, Syngenta

In 2025, monitoring based on molecular data showed high frequency of mutation G143A in France, Germany, Ireland and Sweden.

In 2024, monitoring based on molecular data showed high frequency of mutation G143A in Bulgaria, Germany, France, Hungary, Ireland, Lithuania, Poland, Sweden and UK, whereas moderate frequency was reported from Italy, Spain and Switzerland. One sample from Greece showed no mutation.

Monitoring in 2023 based on molecular quantification of G143A showed the following results:
High frequency of resistance was found in Croatia, France, Germany, Hungary, Ireland, Poland, Romania, Slovenia and Switzerland.
Moderate frequency was detected in Italy and Spain.

Brown rust / Dwarf rust (*Puccinia hordei*), barley

Companies: Bayer, Syngenta

Monitoring based on bioassay in 2025 has been carried out in Belgium, France, Germany, Poland, and United Kingdom.
As in 2024, in 2025, monitoring showed full sensitivity.
Again, as in previous years single isolates with slightly lower sensitivity in discriminatory dose tests has been detected; sequencing of the cyt b did not show known mutations like F129L or G143A.

As 2023 in 2024, monitoring based on bioassay in Belgium, Denmark, France, Germany, Lithuania, Sweden and United Kingdom showed full sensitivity.
Again as in previous years single isolates with slightly lower sensitivity in discriminatory dose tests has been detected; sequencing of the cyt b did not show known mutations like F129L or G143A.

Monitoring in 2023 based on bioassay and molecular studies showed full sensitivity situation in Belgium, Bulgaria, Denmark, France, Germany, Hungary, Italy, Poland, Romania, Sweden und United Kingdom.
As in previous years single isolates with slightly lower sensitivity in discriminatory dose tests has been detected, but no F129L or G143A mutation were present.

Barley stripe disease (*Pyrenophora graminea*)

Companies. Syngenta

In 2024, a few isolates from Lithuania and Sweden were sensitive.

Limited monitoring in 2023 from Finland and Poland showed full sensitivity based on bioassay.

***Ustilago* spp (smut of barley)**

Companies: Syngenta

In 2024, limited monitoring based on bioassay in Austria, Bulgaria, France, Germany, Hungary, Lithuania, Poland and Spain showed full sensitivity.

Monitoring in 2023 based on bioassay showed full sensitivity in Czech Republic, France, Germany, Hungary, Italy, Lithuania, Poland and United Kingdom.

2.1.2. Vine diseases

Downy mildew (*Plasmopara viticola*)

Companies: BASF, Bayer, Corteva and Syngenta

Based on bioassay and molecular information in Austria, Croatia, France, Germany, Greece, Hungary, Italy, Portugal, Spain, Switzerland and Türkiye the resistance situation 2025 is as follows:
High frequency of resistant samples is observed in Portugal, Spain and Türkiye,
Low to Moderate frequency in Germany, Greece, Hungary, Italy and Switzerland,
No to high in Croatia and France, but overall low frequency.

Based on bioassay and molecular information of the resistance situation 2024 is as follows:
High frequency of resistant samples is observed in Portugal and Türkiye, and in a limited number of samples in Greece.
Moderate levels were detected in Austria (limited samples), Croatia, Germany, Hungary and Spain.
Extensive monitoring showed variable frequency of resistance from no to high in France and Italy.

Monitoring in 2023 showed continued tendency of decreased frequency of resistance as observed already in previous year.
The frequency of G143A mutation has been studied in the following countries:
Moderate to high frequency was reported in Greece and Türkiye;
Low to high frequency were detected in France, Germany, Italy, Portugal and Spain.

Findings in 2022:
Results of monitoring in 2022 showed a stable situation with a tendency to lower frequency of G143A in many European populations compared to previous seasons.
The frequency of G143A mutation has been studied in the following countries:
Moderate to high frequency was reported in, Greece and Türkiye;
Moderate frequency in Spain;
Low to high frequency in Bulgaria, Croatia, France, Germany, Hungary, Italy Portugal, Slovenia and Spain.
Low to moderate in Austria, Bulgaria
Low in Romania

Additional information: After numerous years of sensitivity monitoring carried out in Europe it has been observed the levels of resistance found are very heterogeneous, with values ranging from zero to high even between neighbouring vineyards.

Grape powdery mildew (*Uncinula necator* / *Erysiphe necator*)

Companies: BASF, Bayer, Syngenta

Monitoring for 2024 has been carried out in Austria, Czechia, Greece, France, Germany, Hungary, Italy, Portugal, Romania, Spain, Switzerland and Türkiye.
Bioassay and molecular studies in 2024 showed high frequency of resistance in Austria, Czech Republic, France, Germany, Romania, Spain, Switzerland and Türkiye,
Moderate frequency of resistance was detected in Hungary, Italy and Portugal,
Low frequency in Greece.

Bioassay and molecular studies in 2023 showed high frequency of resistance in Austria, Bulgaria, Croatia, Czech Republic, France, Germany, Greece, Portugal and Türkiye.
Moderate frequency of resistance was detected in Hungary, Romania, Spain and Switzerland.
Low frequency of resistance was observed in Italy.

2.1.3 Pome fruit diseases

Apple scab (*Venturia inaequalis*)

Companies: BASF, Bayer

Findings until 2022:

Data from 2021 and 2022 showed moderate to high frequency in France, Hungary and Italy and high frequency of G143A in all other studied countries (Austria, Belgium, Germany, Denmark, Greece, Hungary, Netherland, Poland, Portugal, Serbia, Slovakia, Spain, Sweden, Switzerland and Türkiye).

Through intensive monitoring carried out in Europe in the past it is known that in regions where resistance is present, the levels of resistance were often very heterogeneous, with values ranging from zero to high even between neighbouring orchards.

Apple Powdery Mildew (*Podosphaera leucotricha*)

Companies: BASF

In 2024, extensive monitoring in Belgium, France, Germany, Greece, Italy, Hungary, Netherlands, Poland, Portugal and Spain showed full sensitive situation.

Additional information: The full sensitivity is most likely to be related to the reported presence of a lethal intron in several fungi making the G143A mutation unlikely to occur (see FRAC document titled “Impact of Intron at G143A on Qo resistance development” located on the FRAC website under QoI fungicides → Quick references).

Brown Rot in Stone Fruit (*Monilinia* spp.)

Companies: BASF, Sumitomo

In 2025 monitoring has been conducted in Belgium, Bulgaria, France, Germany, Greece, Hungary, Italy and Spain.
All samples tested show full sensitivity in *M. laxa*, *M. fructicola* and *M. fructigena.*

In 2024, bioassay showed full sensitivity in *M. laxa*, *M. fructicola* and *M. fructigena* in France, Italy and Spain.

No resistance were found based on bioassay in Belgium, Bulgaria, Germany, Greece, France, Hungary, Italy and Spain in 2022/2023.

Additional information: These findings are most likely to be related to the reported presence of a lethal intron in several fungi making the G143A mutation unlikely to occur in *M. laxa* and *M. fructicola* (see FRAC document titled “Impact of Intron at G143A on Qo resistance development” located on the FRAC website under QoI fungicides (link)).

***Stemphylium vesicarium* on Pears, Onion and Asparagus**

No data was reported since 2020

2.1.4. Storage diseases

***Neofabraea alba* and *N. perennans* (bulls eye rot), apples**

Companies: BASF

Monitoring in 2023 showed still high sensitivity in samples originating from Belgium, Germany and Poland.

Monitoring in 2022 showed sensitive situation based on bioassay in Belgium, France, Germany, Italy and Poland.

2.1.5. Potato/tomato diseases

Late blight (*Phytophthora infestans*)

Companies: BASF, Corteva, Syngenta

In 2024 extensive bioassay tests showed full sensitivity in Austria, Belgium, Czech Republic, Denmark, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Spain, Slovenia, Sweden, Switzerland and United Kingdom.

Monitoring in 2023 in Belgium, France, Greece. Netherlands, Portugal and Türkiye still showed full sensitivity.

Early blight (*Alternaria* spp.)

Alternaria solani

Companies: BASF, Bayer, Syngenta

Monitoring based on bioassay and molecular studies were carried out in potatoes (*Alternaria solani*) in Europe from 2020, to 2024.

Potato

Resistance to QoI is associated to the presence of the F129L mutation and molecular information are provided below:

Monitoring has been carried out in 2025 in Austria, Belgium, Denmark, Germany, Netherlands, Sweden and United Kingdom.
Wide spread of F129L mutated strains was observed in all countries.

Extensive monitoring in 2024 based on bioassay and molecular studies showed moderate to high frequency of mutation F129L in Belgium, Germany, Netherlands, Poland, Serbia and Sweden. Heterogeneous situation was observed in France, while samples from Finland, Portugal showed full sensitivity.

Data from 2023 showed a situation as known from previous years:
High frequency was detected in Austria, Belgium, Denmark, Germany, Netherlands and Sweden.
Moderate frequency was detected in France, Latvia and Poland.

Findings in 2022:
Data from 2022 showed a situation as known from previous years:
High frequency was detected in Denmark, Netherlands and Sweden.
Moderate frequency was detected in Austria, Belgium, Germany and Norway

Additional information: As already observed with other pathogens, resistance factors mediated by the F129L mutation are significantly lower in comparison with the G143A mutation and field performance of products used according to FRAC and Manufacturers' recommendations remains good (for differences between QoI mutations see also the respective FRAC document titled "Mutations associated with QoI resistance" available on the FRAC website under QoI fungicides → (link)).

***Alternaria alternata* on potato and tomato**

No monitoring was carried out since 2016 following general high frequency of resistance based on G143A in most of the included countries.

***Alternaria tomatophila* on Tomato**

Companies Syngenta

Monitoring from 2019 and 2020 showed presence of resistance based on G143A in Croatia, Italy, Poland and Spain. Full sensitivity was observed in Bulgaria, Greece, Hungary and Romania.

Potato - Black scurf (*Rhizoctonia solani*)

Companies: Syngenta

No recent reports available. Last information is from 2017.

In 2017 less sensitive isolates were detected in China (Inner Mongolia, Hebei, and Gansu) at low frequency.

Low: In 2016 a small number of fields in Louisiana, USA were found to contain less sensitive isolates.

2.1.6. Soybean diseases

Asian Rust (*Phakopsora pachyrhizi*)

Companies: BASF, Bayer, Corteva, FMC, FRAC Brazil, Syngenta

Findings:

High frequency of F129L mutation has been observed in season 2025/26 as known from previous years in Brazil.

High frequency of F129L mutation has been observed in season 2024/25 as known from previous years in Brazil.

High frequency of F129L mutation has been observed in season 2023/24 as known from previous years in Brazil.

Analysis of historic samples showed that the F129L mutation was present at significant levels from at least 2012/13.

Additional information: As already observed with other pathogens, resistance factors resulting from the F129L mutation are significantly lower in comparison with the G143A mutation.

(see FRAC document titled “Mutations associated with QoI resistance” available on the FRAC website under QoI fungicides →Quick references).

No samples containing the G143A mutation have been found in this pathogen. These findings are consistent with the reported presence of a lethal intron in several fungi making the G143A mutation unlikely to occur (see FRAC QoI Intron Document).

Target Spot (*Corynespora cassiicola*)

Companies: BASF, Corteva, FMC, Sumitomo, Syngenta

Monitoring was performed in seasons 2025/26
High frequency and widespread presence of mutation G143A across Brazil has been reported as in previous years.

Monitoring was performed in seasons 2024/25
High frequency and widespread presence of mutation G143A across Brazil has been reported as in previous years.
Monitoring was performed in seasons 2023/24
High frequency and widespread presence of mutation G143A across Brazil has been reported as in previous years.

Cercospora leaf blight (*Cercospora* spp.)

Companies: FMC, Corteva, Syngenta

No data for the 2025/26 season

In 2023/2024 as well as in 2024/25 season high frequency of QoI resistance has been reported (bioassay as well as molecular studies) in Brazil confirming results from previous years.

Anthracnose (*Colletotrichum* spp, involved in stem and pod rot anomalies)

Companies: Syngenta

No monitoring has been carried out in the 2025/26 season

Initial monitoring based on bioassay showed high frequency of resistance in 2021/22 and 2022/23 season.

***Diaporthe* spp (involved in stem and pod rot anomalies)**

Commented [Reviewer1]: Italic

Companies: Syngenta

No monitoring has been carried out in the 2025/26 seasonInitial monitoring based on bioassay showed high frequency of resistance in 2021/22 and 2022/23 season.

Brown spot of soybean (*Septoria glycines*)

Commented [Reviewer2]: *Septoria glycines*

Companies: Sumitomo

Limited monitoring has been carried out in 2024/25 and 2025/26 season in Brazil. All tested isolates were resistant in bioassay.

Commented [Reviewer3]: In Sumitomo's result, all isolates were "resistant" for group 11, while they were all sensitive to 11A.

2.1.7. Other crops

Vegetables

Cucumber downy mildew (*Pseudoperonospora cubensis*)

Companies: BASF, Syngenta

Monitoring based on molecular methods has been carried in Vietnam in 2025.
High frequency of G143A was found in South of Vietnam and moderate frequency in North of Vietnam.

In 2024, extensive monitoring in Vietnam showed widespread resistance. A limited monitoring in Europe (France, Portugal and Spain) showed that most samples were resistant.

Limited monitoring with samples collected in Northern Vietnam in 2022 and 2023 showed presence of G143A mutation.

***Corynespora cassiicola* from cucurbits**

Companies: BASF

No recent monitoring was carried out.

Cucurbits - Gummy stem blight (*Didymella bryoniae*)

Company: Syngenta

No recent monitoring was carried out.

Cucumber powdery mildew (*Sphaerotheca fuliginea= Podosphaera xanthii and Golovinomyces cichoracearum)*

Companies: Bayer, (Syngenta)

No recent reports available. Last information is from 2017.

***Alternaria* spp. on various vegetables**

Companies: Syngenta

Alternaria alternata (cabbages):

Limited samplings from 2017 to 2022 across European cabbage growing countries showed in general sensitivity, however, in some regions single resistant strains with G143A were detected.

Alternaria dauci:

In 2022 limited monitoring based on bioassay showed resistance in a single location in Italy

***Alternaria brassicicola*:**

All samples from 2019 were sensitive from Belgium, Croatia, France and Spain (Cauliflower, broccoli)

Alternaria brassicae:

All samples from 2019 were sensitive from Belgium, Croatia, France and Spain (Cauliflower, broccoli, cabbages).

Spinach

Stemphylium botryosum

No data were reported since 2020.

Soft fruits

Gray Mold (*Botrytis cinerea*)

Companies: BASF, Bayer

In 2025 monitoring based on bioassay and molecular methods has been carried out in Belgium, France, Germany, Italy, Latvia, Netherlands, Poland, Portugal, Romania and Spain.

High frequency of resistance has been detected in Poland, Netherlands and Spain,
Moderate frequency in France, Germany, Italy and Portugal,
Low frequency in Romania,
Full sensitivity has been reported in Belgium and Latvia.

Extensive monitoring in 2024 showed high frequency of G143A in Germany, Italy, Netherlands, Poland and United Kingdom moderate frequency in Belgium.

Limited number of isolates from strawberry showed in 2022 and 2023 again high frequency of resistance in Germany (2022) and Poland (2023), while most Italian isolates in both years did not carry the G143A mutation.

Grapes

Gray Mold (*Botrytis cinerea*)

Companies: Bayer

In 2025 Monitoring based on bioassay and molecular methods has been carried out in France and Italy.
Frequency of resistance was moderate in France and low in Italy.

2024 monitoring based on molecular assays showed high frequency of resistance in Germany. Low to moderate frequency of resistance in samples from Italy.

In 2022 and 2023 monitoring based on molecular data showed high frequency in Germany and France (only 2023) and still low frequency in Italy.

Additional information: QoI sensitive (cyt b wild type) strains often could be divided in isolates carrying or not carrying the intron in the cytochrome b gene. (link to intron (see FRAC document titled “Mutations associated with QoI resistance” available on the FRAC website under QoI fungicides (link)).

Oilseed Rape (Canola)

Stem Rot (*Sclerotinia sclerotiorum*) OSR

Companies: BASF, Bayer, Sumitomo and Syngenta

Monitoring based on bioassay has been carried out in 2025 in Denmark, France, Germany, Hungary, Lithuania, Poland, Romania and Sweden.
Full sensitivity as in previous years has been observed in all countries.

In 2024, extensive monitoring based on bioassay showed full sensitivity in Denmark, France, Germany, Hungary, Latvia, Lithuania, Poland and UK. Sweden, Estonia.

Results from 2023 monitoring based on bioassays showed full sensitivity in Czech Republic, France, Germany, Poland, Romania and Slovakia.

Additional information: Sporadic cases of reduced sensitivity observed in lab studies underlines the need to use inhibitors of the alternative oxidase (AOX), such as SHAM or propyl-gallate, in sensitivity tests. Relevance of the AOX in practice needs further elucidation.

Blackleg (*Plenodomus lingam, P. biglobosus, syn.: Leptosphaeria maculans and L. biglobosa*)

Companies: BASF

Monitoring based on bioassays in 2024/25 season in Czechia, Estonia, Germany, Lithuania, Poland, Romania, Sweden and United Kingdom.
All isolates were measured as sensitive.

In 2023/24 monitoring, full sensitivity was found in Czech Republic, Denmark, Germany, Latvia, Lithuania, Poland, Romania and Sweden for both species. As in the previous years, *P. lingam* was more frequently detected than *P. biglobosus*

Monitoring from 2022/23:
Full sensitivity was found in Austria, Czech Republic, Denmark, France, Germany, Poland, Romania, Sweden and United Kingdom for both species. As in the previous years, *P. lingam* was more frequently detected than *P. biglobosus*

Light leaf spot on OSR (*Pyrenopeziza brassicae*)

Companies: BASF

In 2023 monitoring showed sensitive situation in Ireland and United Kingdom.

Sunflower

White Mould *(Sclerotinia sclerotiorum)*

Companies: BASF, Corteva

Monitoring in 2024 based on bioassay showed full sensitivity in Germany and Romania.

Monitoring in 2023 based on bioassay showed full sensitivity in Hungary, Poland and Romania

Limited monitoring based on bioassay showed full sensitivity in Romania in 2021 and 2022.

Alternaria helianthi

BASF

Monitoring in 2022 showed full sensitivity in Romania.

Monitoring in 2019, 2020 and 2021 showed full sensitivity in Czech Republic, France, Hungary, Romania and Slovakia.

***Plenodomus lindquistii,* black stem of Sunflower**

Companies; BASF

First monitoring in 2022 based on bioassay showed no indication of resistance in Romania.

Lettuce Downy Mildew (*Bremia lactucae*)

Companies: BASF

Monitoring in 2022 based on bioassays showed full sensitivity in Belgium, Portugal, Spain, Greece and Netherlands

Onion Downy Mildew (*Peronospora destructor*)

Companies: BASF

No monitoring performed in recent years.

In 2016 genetic analysis showed that samples from Germany did not contain any known mutations potentially causing QoI resistance and were therefore classified as sensitive to QoI.

Beans and green beans and lettuce

White Mold, (*Sclerotinia sclerotiorum)*

Companies: BASF, Syngenta

In 2024, monitoring showed full sensitivity in Germany, Netherlands and Spain.

In 2023, monitoring showed full sensitivity in Belgium, France, Germany and Netherlands.

Monitoring based on bioassay of samples from 2019 to 2022 from France (beans, lettuce and green beans), Spain (lettuce) and Netherlands (beans) showed full sensitivity.

Corn

***Pythium* spp.**

Companies: Syngenta

In 2023, isolates from soil of different crops from Belgium, Czech Republic, Denmark, France, Germany, Hungary, Italy, Lithuania, Netherlands, Poland, Romania, Sweden, Switzerland and UK showed unchanged sensitivity compared to the past.

Tested Pythium species are: *P. attrantheridium*, *P. heterothallicum*, *P. lutarium*, *P. sylvaticum* and most strains of *P. ultimum*. Some strains of *P. ultimum* were reported in the past to be tolerant to QoI fungicides, however, in these strains no G143A mutation was found.

Northern leaf blight, corn (*Exserohilum turcicum, Setosphaeria turcica*)

Companies: BASF

Monitoring data based on bioassay from 2018 and 2019 from France, Germany and Italy showed full sensitivity.

Southern leaf blight (*Bipolaris spp* ; *Cochliobolus heterostrophus,* corn)

Companies: BASF

Monitoring data based on bioassay from 2019 from various locations in Italy showed full sensitivity.

Sugar Beet

Cercospora leaf spot (*Cercospora beticola*)

Companies: BASF, Bayer, Syngenta

Monitoring based on bioassay and molecular methods in 2025 in Belgium, France, Germany, Italy, Netherlands, Poland and Ukraine.
High level of resistance is still observed in all samples.

Commented [RDG4]: Should this be frequency rather than levels?

2024 data confirmed high frequency of resistance in samples originating from Belgium, Czech Republic, France, Germany, Italy, Netherlands, Poland, Ukraine and United Kingdom.

In 2023, findings based on bioassay showed high frequency of resistance in Belgium, Czech Republic, France, Germany, Netherlands, Poland and United Kingdom. Moderate frequency of resistance has been detected in Russia.

Rice

***Blast* (*Pyricularia oryzae* = *Magnaporthe oryzae*)**

Companies: BASF, Bayer and Syngenta

Monitoring based on molecular method has been carried out in 2025 in Vietnam. Heterogeneous sensitivity levels has been measured in South Vietnam with overall moderate to high presence of the mutation of G143A.

In 2024 monitoring showed a similar situation of the resistance frequency in Italy: resistance detected in Emilia Romagna, Lazio and Sardegna; no to high frequency across different samples collected in Lombardia and Piemonte.
In Vietnam, extensive monitoring showed similar situation as in previous years with no to high frequency of G143A across the Mekong area.

Extensive monitoring in 2022 from Italy showed a heterogeneous distribution of resistance different from site to site. Moderate levels of frequency were reported mainly from Lombardia, lower frequency in Piemonte. Resistance has been also detected in Emilia Romagna, Lazio and Sardegna.

In 2022/3 monitoring based on molecular quantification of G143A mutation in Vietnam showed a stable situation compared to previous years with no to high percentages in different locations.

Sheath blight (*Rhizoctonia solani*)

Companies: Syngenta

In 2024, monitoring in Vietnam revealed full sensitivity based on molecular assays.

Extensive molecular monitoring in 2022 in Vietnam showed high sensitivity and only one single sample with F129L mutation was detected.

No monitoring was carried out in 2018, 2019 and 2020.

Additional information: For further known cases of QoI resistance, see the document titled “Species with QoI Resistance (2012)” on the FRAC website located under QoI fungicide (link).

Cotton

Ramularia leaf spot (*Ramulariopsis pseudoglycines*, syn. *Ramularia areola*)

Companies: BASF, FMC, Sumitomo

Monitoring in 2023, 2024 and 2025 on country level in Brazil showed still high frequency of resistance in bioassay.

Monitoring in 2023 and 2024 on country level in Brazil showed still high frequency of resistance in bioassay.

Corynespora leaf spot (*Corynespora cassiicola*)

Companies: BASF, Bayer, FMC, Sumitomo, Syngenta

Limited monitoring in season 2025 and 2026 confirmed high frequency of G143A based on molecular analysis wide spread in Brazil.

Moderate intense monitoring in season 2023/24 showed still high frequency of G143A based on molecular analysis wide spread in Brazil.

Fungicides in FRAC code 11A

Cereals

Septoria leaf spot (*Septoria tritici* = *Mycosphaerella graminicola* = *Zymoseptoria tritici*), wheat

Companies: Sumitomo

Intensive monitoring based on bioassay from 2020 to 2025 showed baseline sensitive populations including Germany, France, Ireland, Poland and United Kingdom.

Net blotch (*Pyrenophora teres*), barley

Companies: Sumitomo

Intensive monitoring based on bioassay from 2019 to 2025 showed baseline sensitive populations including Germany, France, Ireland (not in 2025) Poland and United Kingdom.

Soybean and cotton

Ramularia leaf spot *(Ramulariopsis pseudoglycines,* syn. *Ramularia areola)*

Companies: BASF, Sumitomo

Intensive monitoring based on bioassay from 2022 to 2026 showed baseline sensitive populations from cotton originating from Brazil.

Target spot (*Corynespora cassiicola)*

Companies: BASF, Sumitomo

Sensitivity monitoring based on bioassay from 2022 to 2026 showed baseline sensitive populations from cotton and soybeans originating from Brazil.

Brown spot of soybean (*Septoria glycines*)

Companies: Sumitomo

Limited monitoring has been carried out in 2025/26 season in Brazil. All tested isolates were sensitive in bioassay.

2.2. Review of global guidelines

2.2.1 QoI – General Strategies and Guidelines

Strategies for the management of QoI fungicide resistance, in all crops, are based on the statements listed below. These statements serve as a fundamental guide for the development of local resistance management programs.

Resistance management strategies have been further enhanced in order to be proactive and to prevent the occurrence of resistance to QoI fungicides developing in other areas and pathogens. Specific guidelines by crop follow the general guidelines given here.

A fundamental principle that must be adhered to when applying resistance management strategies for QoI fungicides is that:

- The QoI fungicides (azoxystrobin, bifemetstrobin, coumoxystrobin, dimoxystrobin, enoxastrobin, famoxadone, fenamidone, fenaminostrobin, fluoxastrobin, flufenoxystrobin, kresoxim-methyl, mandestrobin, metominostrobin, orysastrobin, pyraoxystrobin, picoxystrobin, pyraclostrobin, pyrametastrobin, pyribencarb, triclopyricarb, trifloxystrobin) are in the same cross-resistance group; FRAC Code 11
- The QoI fungicide in subgroup A (metyltetraprole), Code 11A fungicide, is not cross resistant with Code 11 fungicides in pathogens with G143A mutation.
- Fungicide programmes must deliver effective disease management. Apply QoI fungicide based products at effective rates and intervals according to manufacturers' recommendations. Effective disease management is a critical component to delay the build-up of resistant pathogen populations.
- The number of applications of QoI fungicide based products within a total disease management program must be limited whether applied solo or in mixtures with other fungicides. This limitation is inclusive to all QoI fungicides. Limitation of QoI fungicides within a spray programme provides time and space when the pathogen population is not influenced by QoI fungicide selection pressure.
- Limitation of the total number of QoI applications is detailed in the specific crop recommendations. In consideration of the cross-resistance profile of subgroups 11 and 11A, the maximum allowed number of QoI-containing sprays is increased by one, where both QoI fungicides (code 11) and QoI fungicides in subgroup A (code 11A) are included in a spray program in a given cropping season. All crop-specific recommendations will be regularly reviewed based on sensitivity monitoring.
- A consequence of limitation of QoI fungicide based products is the need to use it in a spray program with effective fungicides from different cross-resistance groups (refer to the specific crop recommendations).
- QoI products, containing only the solo QoI fungicide, should be used in single or

block applications in alternation with fungicides from a different cross-resistance group. Specific recommendation on the number of consecutive treatments (size of blocks) is given for specific crops.

- Mixture partners for QoI fungicides should be chosen carefully to contribute to effective control of the targeted pathogen(s). The mixture partner must have a different mode of action, and in addition it may increase spectrum of activity or provide needed curative activity. Use of mixtures containing only QoI fungicides (including two-way mixtures of code 11 fungicide and code 11A fungicide) must not be considered as an anti-resistance measure.
- An effective partner for a QoI fungicide is one that provides satisfactory disease control when used alone on the target disease.
- QoI fungicides are very effective at preventing spore germination and should therefore be used at the early stages of disease development (preventive treatment).

2.2.2 QoI – Specific Crop/Pathogen guidelines

Specific crop recommendations for FRAC code group 11 A will be prepared in the FRAC QoI working group before the product is available for use.

2.2.2.1. QoI – Strategies and Guidelines for cereals

Where the guidelines were followed, field performance of QoI containing spray programmes was good. It continues to be essential to use non-cross resistant mixture partners (e.g. SBIs, multi-sites) to ensure robust disease management. This will also help to delay the evolution of resistance, especially in regions with no resistance or where resistance is at low levels.

Therefore, the recommendations remain unchanged.

Guidelines for using QoI fungicides on cereal crops:

1. Apply QoI fungicides always in mixtures with non-cross resistant fungicides to control cereal pathogens. At the rate chosen the respective partner(s) on its/ their own has/ have to provide effective disease control. Refer to manufacturers recommendations for rates.
2. The maximum number of QoI-containing sprays is 3, but only when QoI fungicides belonging to both QoI Groups (code 11 and 11A) are included in a spray program. QoI fungicides belonging to the individual Codes (11 or 11A) should not be applied more than 2 times either individually or when mixed together.
3. Apply QoI fungicides according to manufacturer's recommendations for the target disease (or complex) at the specific crop growth stage indicated.
4. Apply the QoI fungicide preventively or as early as possible in the disease cycle. Do not rely only on the curative potential of QoI fungicides.
5. Split / reduced rate programmes, using repeated applications, which provide continuous selection pressure, accelerate the development of resistant populations and therefore must not be used.

2.2.2.2 QoI – Vine diseases

General Guidelines for using QoI fungicides on vines:

Apply a maximum of 4 QoI fungicide containing sprays against any disease per vine crop, and a maximum of 33% of the total number of applications.

QoI – Powdery mildew (*Uncinula necator / Erysiphe necator*)

1. Apply QoI fungicides according to manufacturer's recommendations for the target disease at the specific crop growth stage indicated. Effective disease management is a critical parameter in delaying the build-up of resistant pathogen populations.
2. Apply a maximum of 2 QoI fungicide containing sprays targeted against powdery mildew per vine crop, preferably in mixture (co-formulations or tank mixes) with effective mixture partners from different cross-resistance groups.
3. Apply QoI fungicides preventively.
4. QoI fungicides used solo should be used in strict alternation with fungicides from a different cross-resistance group.
5. Apply QoI fungicides used in mixture in a maximum of two consecutive applications in alternation with fungicides from a different cross-resistance group. In areas where resistance has been confirmed, apply QoI fungicides in strict alternation

QoI – Downy mildew (*Plasmopara viticola*)

1. Apply QoI fungicides according to manufacturer's recommendations for the target disease at the specific crop growth stage indicated. Effective disease management is a critical parameter in delaying the build-up of resistant pathogen populations.
2. Apply QoI fungicides preventively.
3. Apply a maximum of 3 QoI fungicide containing sprays targeted against downy mildew per vine crop, only in mixture with effective partners from different cross-resistance groups.
4. Apply QoI fungicides in single or block application in alternation with fungicides from a different cross-resistance group.

2.2.2.3 QoI – Pome fruit diseases

Guidelines for using QoI fungicides on pome fruits

QoI – Scab (*Venturia inaequalis, Venturia pirina*)

1. Apply QoI fungicides according to manufacturer's recommendations for the target disease (or complex) at the specific crop growth stage indicated and adapted to size of trees. Effective disease management is a critical parameter in delaying the build-up of resistant pathogen populations.
2. QoI fungicides must be applied only in mixture with partners contributing to the effective control of the target pathogens.
3. Apply QoI fungicides preventatively. Under high disease pressure the spray interval should not exceed 7-10 days.
4. Apply a maximum of 3 QoI containing sprays per crop. A maximum of 4 QoI fungicide applications may be used where 12 or more applications are made per crop.
5. A maximum of 2 consecutive QoI fungicide sprays is preferred. Where field performance was adversely affected apply QoI containing fungicides in mixtures in strict alternation with fungicides from a different cross-resistant group.

2.2.2.4 QoI – Potato and tomato diseases

Guidelines for using QoI fungicides on potatoes and tomatoes

QoI – Late blight (*Phytophthora infestans*)

1. Apply QoI fungicides according to manufacturer's recommendations for the target disease (or complex) at the specific crop growth stage indicated. Effective disease management is a critical parameter in delaying the build-up of resistant pathogen populations.
2. Where QoI fungicide products are applied alone do not exceed 1 spray out of 3 with a maximum of 3 sprays per crop. Do not use more than 2 consecutive applications.
3. Where QoI fungicide products are applied in mixtures (co-formulations or tank mixes) do not exceed 50% of the total number of sprays or a maximum of 6 QoI fungicide applications whichever is the lower. Do not use more than 3 consecutive QoI fungicide containing sprays.

QoI – Early blight (*Alternaria solani, Alternaria alternata*)

1. Where QoI fungicide products are applied solo do not exceed 33% of the total number of sprays or a maximum of 4. Where mixtures (co-formulations or tank mixes) are used do not exceed 50% of the total number of sprays or a maximum of 6 QoI fungicide applications, whichever is the lower.
2. Where resistance has been confirmed, QoI fungicides must be applied only in mixture with partners contributing to the effective control of the target pathogens.

2.2.2.5 QoI – Guidelines for use on soybean diseases

QoI fungicides control soybean diseases including rust, which is a major disease in Latin America and has been detected recently in the USA.

In order to ensure sustainable use of QoIs the Working Group recommends:

Apply QoI fungicides according to manufacturer's recommendations for the target disease (or complex) at the specific crop growth stage indicated. Effective disease management is a critical parameter in delaying the build-up of resistant pathogen populations.

1. Use QoIs preventatively or as early as possible in the disease cycle.
2. Use QoIs preferably in mixtures (co-formulations or, where permitted, tank mixes) with fungicides from a different cross-resistance group. At the rate chosen each partner on its own has to provide effective disease control. Refer to manufacturers' recommendations for rates. In regions where target site mutations in key target soybean pathogens are present mixtures are mandatory.
3. Limiting the number of sprays containing QoI fungicides is an important factor in delaying the build-up of resistant pathogen populations.

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 varietal tolerance, reduce the planting window, give preference to early-cycle varieties or endorse the destruction of volunteers.

2.2.2.6 QoI – Guidelines for use on sugar beet

QoI – *Cercospora beticola*

1. Apply QoI fungicides according to manufacturer's recommendations for the target disease (or complex) at the specific crop growth stages indicated. Effective disease management is a critical parameter in delaying the build-up of resistant pathogen populations.
2. QoI fungicides must be applied only in mixture with partners from a different cross-resistance group, contributing to the effective control of the target pathogens.
3. Apply QoI fungicides preventatively. Under high disease pressure the spray interval should not be extended.

The maximum number of QoI-containing sprays is 3, but only when QoI fungicides belonging to both QoI Groups (code 11 and 11A) are included in a spray program. QoI fungicides belonging to the individual Codes (11 or 11A) should not be applied more than 2 times either individually or when mixed together

Do not exceed 50% of the total number of sprays with QoI containing products. In low disease pressure situations where only 1 fungicide application is required for disease control then a QoI – containing mixture (as defined above) may be used. In areas

where ‘exactly’ three applications are expected, a maximum of one QoI 11 and a maximum of two QoI 11A may be applied so long as not more than two QoI applications are made in total.

Where QoI fungicides are used targeting other sugar beet diseases (e.g. rust, powdery mildew, *Rhizoctonia*, *Ramularia* and *Stemphylium*) then the potential impact of applications on the resistance management of *Cercospora beticola* should be considered. Where *Cercospora beticola* is not a disease of importance (e.g. in a certain geography) then the general guidelines for QoI fungicides apply.

2.2.2.7 QoI – Cucurbit diseases

Guidelines for using QoI fungicides on Cucurbit Vegetables

1. Apply QoI fungicides according to manufacturer's recommendations for the target disease (or complex) at the specific crop growth stage indicated. Effective disease management is a critical parameter in delaying the build-up of resistant pathogen populations.
2. Apply a maximum of 3 QoI fungicide sprays per crop
3. Use a maximum of 1 QoI fungicide spray out of every three fungicide applications.
4. Do not use consecutive applications of QoI fungicides.
5. Apply QoI fungicides in alternation with fungicides from a different cross-resistance group with satisfactory efficacy against the targeted pathogen(s).
6. Continue QoI fungicide alternation between successive crops.

2.2.2.8 QoI – Guidelines for use in greenhouse grown non-cucurbit vegetables

1. Apply QoI fungicides according to manufacturer's recommendations for the target disease (or complex) at the specific crop growth stage indicated. Effective disease management is a critical parameter in delaying the build-up of resistant pathogen populations.
2. Use a maximum of 1 QoI fungicide spray out of every 3 fungicide applications.
3. Do not use consecutive applications of QoI fungicides.
4. Apply QoI fungicides in alternation with fungicides from a different cross-resistance group with satisfactory efficacy against the targeted pathogen(s).
5. Continue QoI fungicide alternation between successive crops.

2.2.2.9 QoI – Guidelines for use in other multiple spray crops (non-cucurbit field vegetables and ornamentals)

1. Apply QoI fungicides according to manufacturers´ recommendations for the target disease (or complex) at the specific crop growth stage indicated. Effective disease

management is a critical parameter in delaying the build-up of resistant pathogen populations.

2. Observe spray limitations in the spray guideline table shown below for programmes utilising 12 or fewer fungicide sprays per crop.

Spray guideline table:

Total number of spray applications per crop	1	2	3	4	5	6	7	8	9	10	11	12	>12
Maximum recommended Solo QoI fungicide sprays	1	1**	2**	2	2	2	2	3	3	3	3	4	*
Max. recommended QoI fungicide sprays in mixture	1	2	2	2	2	3	3	4	4	5	5	6	*

* When more than 12 fungicide applications are made, observe the following guidelines:

i. When using a QoI fungicide as a solo product, the number of applications should be no more than 1/3 (33%) of the total number of fungicide applications per season.

ii. For QoI mixes in programs in which tank mixes or pre mixes of QoI with mixing partners of a different mode of action are utilized, the number of QoI containing applications should be no more than ½ (50%) of the total number of fungicide application per season.

iii. In programs in which applications of QoI are made with both solo products and mixtures, the number of QoI containing applications should be no more than ½ (50%) of the total number of fungicide applied per season.

** Mixtures are preferred.

2.2.2.10 QoI – Guidelines for use on Rice

Rice Blast (*Pyricularia oryzae, Magnaporthe oryzae*)

1. Apply a maximum of 2 foliar treatments per season.
2. Use QoI fungicides only in mixtures with non-cross resistant fungicides. At the chosen rate, the respective partner(s) on its/ their own has/ have to provide effective disease control. Refer to manufacturers recommendations for rates.
3. Apply QoI fungicides in programs with fungicides of different mode of actions.
4. Although QoI fungicides for seed production should be avoided, the very limited amount of different modes of action available for rice blast control could justify QoI uses (in mixtures) only in areas without confirmed QoI resistance.
5. Apply QoI fungicide based products at effective rates and intervals according to manufactures'' recommendations.

6. To keep good field sanitation, avoid transplanting diseased seedlings, remove or destroy primary infection source e.g. left-over seedlings, infested straw and chaff.

QoI – seedling box, paddy granule or seed treatment applications in Rice

QoIs are and will be used as seedling box, paddy granule or seed treatment products.

It is FRAC's objective to protect this fungicide group and integrate all uses into technical recommendations. These minutes contain a recommendation on seed treatments, including those which have efficacy on foliar pathogens.

These recommendations will be reviewed regularly and supported by monitoring. When a QoI fungicide is used as seedling box, paddy granule or seed treatment on rice, there should be no implications regarding QoI FRAC guidelines on the use of foliar QoI fungicides on the same crop as long as the QoI seedling box, paddy granule or seed treatment is directed by rate and efficacy against seed and soil borne diseases or 'low risk' foliar pathogens (Link to FRAC pathogen risk classes).

QoIs used as seedling box, paddy granule or seed treatment in rice providing foliar efficacy against pathogens with moderate/ high resistance risk count against the total number of QoI applications.

If QoI seedling box, paddy granule or seed treatment with foliar efficacy has been used, first foliar application have to be made with a different mode of action in the vegetative phase before subsequent QoI-based foliar sprays in the reproductive phase.

Please refer to the recommendations of Japan-FRAC:

https://www.jcpa.or.jp/labo/jfrac/

2.2.2.11 QoI – Banana

Guidelines for using QoI fungicides on banana

Please refer to the recommendations of the banana FRAC working group: The conclusions and guidelines of the 2018 meeting of the FRAC Banana Working Group are available on the FRAC Website (https://www.frac.info/frac-teams/working-groups/banana-group/recommendations-for-bananas). The next meeting of the group is planned for spring 2026.

2.2.2.12 QoI – Other crops and pathogens

Crops and pathogens not covered above with a specific recommendation, follow the general guidelines (2.2.1).

3. Communication plans

The above Web Pages will serve as the main communication vehicle for the group.

4. Next meetings:

All crops:

Next regular meeting is planned for 17th and 18th March 2027.

Soybean and cotton update meeting planned in September 2027 (date to be confirmed).

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