Anilinopyrimidines (AP's) Working Group

Meeting on March 24, 2025, 1:30 pm - 5:15 pm
Protocol of the discussions and use recommendations of the AP's Working Group of the Fungicide Resistance Action Committee (FRAC)

Participants

BASF	Nadine Riediger Gerd Stammler
Bayer	Andreas Mehl Daniela Portz
K-I Chemical	Hidehiko Yamamoto (excused) Susumu Abe (excused)
Syngenta	Lorenzo Borghi James Fountaine

Venue:

The Westin Grand Frankfurt

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

1.1 *Botrytis* results

Vineyards
(BASF, Bayer, K-I Chemical, Syngenta)

In 2024, sensitivity data from commercial vineyards and trial sites were presented for France, Italy, Spain, Germany, and Croatia.
Overall, 2024 data still reflect a comparable sensitive situation as observed during the previous years. The frequencies of resistant strains were varying in Europe from zero to moderate with regional variability.
These results continue to demonstrate a similar sensitivity across all studied European grape growing regions and confirm effective implementation of resistance management strategies over the past decade.

Historical background:
As in 2020, in 2021, 2022, and 2023, sensitivity data from commercial vineyards and trial sites were presented for France, Italy, and Spain in the major wine growing regions, and partly as well from Croatia, Czech Republic, Germany, Hungary, Poland, Portugal, and Switzerland. Data from these studies show that frequencies of resistant strains was generally low and still varied in Europe from zero to moderate with regional variability.
These results still reflect a stable situation and are comparable to the observations made since more than a decade.

Products, applied according to the FRAC-AP guidelines in grape spray programs, maintained good performance in the field.

Strawberries
(BASF, Bayer, Syngenta)

In 2024, sensitivity monitoring was carried out in Austria, Belgium, Germany, Switzerland, Italy, Poland, and Spain, from commercial locations and trial sites.
Data show that the frequency of resistant isolates is varying between regions from low to high.
Overall, the frequency of resistance detected in strawberries is higher than in grapes.

Historical background:
In 2020, in 2021, 2022, and 2023 sensitivity monitoring was carried out across Europe (such as Belgium, Croatia, Finland, France, Germany, Greece, Netherlands, Italy, Poland, Slovenia, or Spain), from commercial locations and trial sites.
Data show that the frequency of resistant isolates is moderate, fluctuating from field to field, and still ranging from zero to high. Compared to data obtained a decade ago, the frequency of resistant isolates in the monitored populations remained stable.

Products, applied according to the FRAC-AP guidelines in strawberry spray programs, provided good control in commercial situations.

Vegetables
(Syngenta, BASF)

No monitoring has been carried out in 2024.

Historical background:
2023: limited monitoring in bean samples originating from 4 locations from France showed full sensitivity with the exception of 1 isolate.

In 2022, limited sensitivity data for tomato samples collected in three locations in Greece, Italy, and the Netherlands show heterogeneous populations with varying frequencies of resistant isolates.

As in the last years, in 2020 and 2021, limited sensitivity data for tomato, lettuce, and cucumber showed a variable situation with sensitive and resistant isolates in samples originating from France and Spain.

In 2019, limited sensitivity data for tomato samples collected in a single location in Southern Italy indicated presence of resistant isolates.

Evidence from field and laboratory trials has shown that there is a medium resistance risk of *Botrytis* to APs. Good agronomic practices and strict adherence to the FRAC AP use guidelines are crucial to ensure that APs remain effective due to the risk of increasing occurrence of multiple resistant strains and isolates with unspecific, increased efflux activity (often called `multidrug resistant´, MDR), particularly in soft fruits.

For more information on the different AP resistance types, refer to publications on AP related resistance research (e.g., Mosbach *et al*., 2017).

1.2. *Venturia* results
(BASF, Syngenta)

2024 monitoring data were presented for samples originating from France, Belgium, Croatia, Germany, Netherlands, Poland, Portugal, Türkiye, Austria, Hungary, Greece, and Spain.
In 2024, more moderate or strongly adapted populations have been detected in most European apple growing regions compared to previous years.
These findings emphasize once more, that resistance management strategies need to be followed.

Historical background:
2022 monitoring data were presented. Samples originating from France, Belgium, Bulgaria, Croatia, Germany, Romania, Italy, Netherlands, Portugal, Türkiye, Latvia, Lithuania, Austria, Hungary, Greece, Slovenia, and Spain were analysed.
As in the past years, the vast majority of all studied samples was sensitive.
These findings emphasize once more, that current resistance management strategies are effective.

In 2019, 2020 and 2021, a multitude of European samples were analysed. Based on dose-response to APs using *in vivo* biotests, populations are classified as either sensitive, moderately adapted, or resistant.
During all these years, most of all studied samples were sensitive, indicating that current resistance management strategies are efficient.

1.3. *Stemphylium vesicarium*
(Syngenta)

No monitoring carried out since 2021.

Monitoring data has been presented for isolates originating from Portugal, UK, Croatia, Belgium, Germany, Spain, Greece, Italy, Netherlands, and Poland during 2015-2021, sampled in asparagus and pears.

In summary, the majority of all studied isolates were fully sensitive. However, single resistant isolates were detected in both crops.

1.4. *Alternaria solani* (potatoes)
(Bayer)

2023 and first 2024 monitoring data were presented. Samples from Belgium, Netherlands, Germany, Sweden, Denmark, and Austria still showed full sensitivity.

Historical background:
2022 monitoring data were presented.
Samples from Norway, Denmark, and Austria again showed full sensitivity.

2021 samples originating from the Netherlands, Austria, Germany, Denmark, and Sweden still showed high sensitivity.

In 2020, samples from the Netherlands, Austria, Germany, Norway, Denmark, Sweden, and Belgium were analysed. High sensitivity was reported.

First monitoring data has been generated in 2019 for European isolates originating from Belgium, Germany, Netherlands, Denmark, and Sweden.
All isolates showed high sensitivity in a narrow range.

1.5. *Monilinia spp.* (stone- and pome fruit)
(BASF, Syngenta)

In 2024, samples studied were originating from France, Bulgaria, Switzerland, Spain, and Italy. Most of the isolates remained sensitive, particularly in France, Italy, and Bulgaria. A few outliers with higher EC_{50} values were detected in France and Switzerland.

Historical background:
In 2023, samples studied were originating from Hungary, France, Greece, Belgium, Bulgaria, Germany, Spain, Croatia, and Italy. As in the previous years, most of the isolates were fully sensitive, while again a small minority of strains showed lower sensitivity.

In 2021 and 2022, samples from Switzerland, Czech Republic, Germany, Spain, France, Croatia, Greece, Hungary, Italy, Poland, Portugal, and Romania were analysed. AP sensitivity was, overall, high with some variations in the baseline, dependent on the species (*M. laxa, M. fructicola, M. fructigena*), and especially with partly higher EC_{50} values for *M. fructigena*.

First and preliminary monitoring data have been generated in 2020 for European isolates originating from Portugal and Greece.
All isolates were sensitive and EC_{50} values showed a normal frequency distribution.

1.6. *Neofabraea spp.* (pome fruit)
(BASF)

In 2023, extensive monitoring of samples originating of Germany, Belgium, and Poland showed full sensitivity.

Historical background:
2022 samples studied were originating from Belgium, Italy, Germany, France, and Poland. Most of the isolates were fully sensitive, however, some strains from Belgium showed lower sensitivity.

2. AP - Use Recommendations

The purpose of the use guidelines for AP containing products is to maintain the sensitivity in the target pathogens and to prevent crop losses due to resistant pathogen populations.

2.1 AP - Guidelines

For grey mold and apple scab control, specific guidelines have been developed. In general, where different AP-containing products are used in one season, the cumulative number of applications with cyprodinil-, pyrimethanil- or mepanipyrim-containing products must not exceed the maxima as mentioned below.
For sound resistance management, good agricultural practices, including phytosanitary measures and crop protection, should be followed not only in commercial practice, but also in nurseries.

The use recommendations were reviewed during the meeting on March 24th, 2025. The *Botrytis* and *Venturia* guidelines have not been changed.
For all other pathogens and crops, specific guidelines are not yet regarded to be needed. However, the maximum number of applications should be limited and should not exceed more than 50% of all treatments.

2.1.1 AP - *Botrytis* Guidelines

- Where up to three treatments are made per season, the number of applications of AP-containing products is limited to one.

- In situations where four to six Botrytis treatments are made per crop and season, a maximum of two applications with AP-containing products are recommended.
- In specific situations where seven or more Botrytis treatments are required per crop and season, a maximum of three applications with AP-containing products is recommended and not more than two consecutive applications.
- For specific crops and products, follow use recommendations of individual companies.

2.1.2 AP - *Venturia* Guidelines

- Apply a maximum of four AP-containing products per season.
- In locations where moderately adapted or resistant populations have been reported, use APs only in mixture with an effective non-cross-resistant scab fungicide.
- Individual products should always be used at recommended dose rates and during the period when they are most effective.
- Curative use only in conjunction with reliable scab warning systems.

The next AP FRAC Working Group meeting is scheduled for March 2026.

Literature

Mosbach *et al*., 2017: Anilinopyrimidine Resistance in *Botrytis cinerea* is linked to Mitochondrial Function, Front. Microbiol., https://doi.org/10.3389/fmicb.2017.02361