

Fungicide Resistance Action Group-UK

FRAG - UK



FRAG-UK 44th Meeting

10:30, Thursday 15th November 2018

Rothamsted Research, West Common, Harpenden, Hertfordshire, AL5 2JQ

Minutes

Present	
Chairman	Prof F Burnett
Secretary	Mr P Ashby (HSE/CRD)
Members	Mr M Ashworth (Corteva) Dr K Maguire (Bayer CropScience) Dr P Gosling (AHDB) Mr B McKeown (BASF) Mr B Clark (NIAB -TAG) Mr M Thompson (AICC) Mr A Bailey (Adama) Dr B Fraaije (Rothamsted) Mr R Dyason (Nu Farm) Dr N Paveley (ADAS) Dr D Ellerton (Hutchinsons) Dr L Cooke (Specialist/QUB) Mr E Bingham (Belchim) Mr A Horgan (Certis) Dr G Kemmitt (FRAC) Dr S Kildea (Teagasc) Dr J Tatnell (Syngenta)
Guests	Dr N Hawkins (Rothamsted) Dr K Hales (AHDB)
Apologies	Dr J Turner (FERA) Dr T Fleming (AFBI) Mr J Sellars (Dow) Mr D Pendergrast (Arysta)

A copy of the current FRAC anti-trust guidelines was circulated during the meeting. BASIS qualified members were invited to sign the circulated attendance sheet if they wished to claim the available points.

1 MEMBERSHIP

Chair acknowledged the longstanding commitment and contribution to the group made by Dr M McPherson (STC). Following his retirement there is still a vacancy for a Horticulture representative from the independent sector. Sec had made an unsuccessful attempt to contact John Clarkson (Warwick Crop Centre). AH volunteered to speak to John Clarkson and suggested Dave Talbot (ADAS) as another alternative.

Post meeting note: AH informed Sec that John Clarkson is willing to join the group

ACTION: Sec to formally invite John Clarkson (post minute note: Done)

2. CONFIRMATION OF PREVIOUS MINUTES

5.1a Sec amendments to minutes of 42nd meeting accepted with no further comment.

5.1b Sec amendments to minutes of 43rd meeting requested by KM were accepted. KM agreed to provide Sec with a summary of BCS strawberry sensitivity testing to add to minutes.

5.1c BM requested a change to the 43rd minutes – page 6 under Section 9.1, BASF monitoring results, replace 'T79R' with 'T79N'.

ACTION: Sec to revise and circulate 43rd minutes (post meeting note: Done)

5.7 A summary of the 2017 cereal disease sensitivity testing monitoring from Bayer and Dupont were presented by KM and MA at the 44th meeting and are included under 8 below.

3. ACTIONS FROM PREVIOUS MEETING

5.2 Addressed under Membership

5.3 Addressed at 5.2

5.4 Sec met with AIC and received a muted response to the proposed Mode of Action icon labelling changes. Following a supporting letter from the RAG Chairs and previous discussion with CPA, CRD has committed to implement the change, but currently have other priority approvals related work so the implementation will be delayed. The MOA labelling will not be strictly defined in terms of exact size and location on the label. Manufacturers/marketing companies are at liberty to go ahead and make the proposed changes to labels before CRD makes an announcement, but they are advised to follow the published Crop Life International recommendations.

5.5 GK confirmed had recently forwarded a copy of the short minutes from the latest SC meeting. He will investigate why this has not been happening recently and remind Duncan McKenzie to do so. Minutes are usually available 1-2 months after the meetings. See also 4 below

5.6 Addressed at 5.1

5.7 Addressed at 8

5.8 Addressed at 5.2

4. FRAC Update (GK)

GK provided a review of the key points from the last Steering Committee (SC) meeting.

FRAC indicated that they would be prepared to make funds available for the SMART sustainability programme if it was fully supported, however as this was not currently the case FRAC will not be providing funding in 2018/2019.

The EPPO initiative to develop a resistance database is progressing. Sec confirmed that this was designed initially to bring together confirmed cases from EPPO countries into a single place as a point of information for use by regulators. In the case of the UK it will use the FRAG-UK list as its source material (see 5.2 below). FRAC are also considering a database of global resistance cases. GK also indicated that there is a separate French initiative proposed (R4P) which aims to implement a national system of uniform labelling across different PPP groups. This does not tie in with the Crop Life International MOA labelling and FRAC have expressed concern over the confusion it could cause.

FRAC have produced a new definition of resistance in response to a FRAG-UK request for clarification. It is aimed at the global audience and so has to cover a lot. GK agreed to forward this to the FRAG-UK Chair.

ACTION: GK to forward revised FRAC resistance definitions to FRAG-UK Chair (post meeting note: Done)

The FRAC statement on the importance of multi-sites has been completed and is available on the FRAC web-site.

FRAC has updated its list of resistant pathogens which is now published on the FRAC website.

FRAC has been funding a project looking for possible agricultural sources of azole resistance in *Aspergillus* species following reported human fatalities caused by azole resistant *Aspergillus fumigatus* in immuno suppressed patients. No cases of azole resistant *Aspergillus* have been detected in wheat fields. BF will publish a paper on this soon and may provide an update at the next FRAG-UK meeting if the work is completed by then.

Under the current constitution a FRAC Working Group requires at least 2 manufacturers. FRAC is trying to encourage more information on resistance to actives outside the Working Groups to be made available. However, it can't force the companies who own these actives to do it. Actives are only added to the FRAC MOA poster if the company concerned agrees.

GK reminded members that FRAC have developed a mobile MOA APP which is based on the FRAC MOA poster. It is updated annually usually around March.

The SC has agreed in principle to a project which will explore the concepts of alternating use of fungicides in sequence or in blocks.

Finally, GK explained that he was not present at the last SC which is why there was no reported update from FRAG-UK

5. FRAG-UK Guideline

5.1. Soft Fruit

PG flagged up the first draft of a Soft Fruit resistance guide he had prepared in response to concerns that there was currently no FRAG-UK advice in this sector. It was agreed that members would feedback comments by 20th December. Some members indicated they had not seen the document.

ACTION: Sec agreed to circulate (post meeting note Done, email 19/11). Interested members were invited to send comments to PG by 20 December.

5.2. General Fungicide Resistance Leaflet

Sec noted that this 2012 document now requires considerable updating. GK will send Chair the revised FRAC definitions statement. Chair will consider amendments to FRAG-UK definition and the overall message particularly IPM statements and then circulate.

The pathogen list for the UK needs updating. Members discussed a number of potential changes primarily relating to diseases where resistance is already acknowledged in the more recently published FRAG-UK crop recommendations. Of particular note was the fact that members formally agreed that the list should acknowledge that resistance to SDHI's in *M graminicola* now exists in the UK.

Sec agreed to send a list of the proposed changes to Table 1 and Table 2 to the Chair.

In addition Chair and NP agreed to consider the resistance status of diseases listed in Table 1 Grimmer *et al* paper and update the FRAG-UK tables accordingly.

Ref: Fungicide resistance risk assessment based on traits associated with the rate of pathogen evolution. Michael K Grimmer, Frank van den Bosch, Stephen J Powers and Neil D Paveley
Post meeting note: Sec has sent proposals for changes in Table 1 and 2 to the Chair. Sec has also requested that Judith Turner uses Liaison to provide an update of the currently authorised actives (Table 4).

ACTIONS: Sec to send proposed changes to Chair (post meeting note Done email 6/12). Chair, NP and JT to consider changes. Chair to send proposed revisions to Sec by 08 Feb 2019. Sec to circulate revised version to whole group ahead of the next meeting. (post minute note: Ongoing)

6. Fungicide Futures

PG indicated that work on developing two new Fungicide Futures publications combining information from a number of publications is near complete and would circulate when they are ready.

Post meeting note: Sec forwarded 2 Fungicide Futures publications Practical measures to combat fungicide resistance in pathogens of barley and wheat on 10 Dec.

7. Research Updates

7.1. BF presented results for his 2018 sensitivity testing. There were large shifts in *in vitro* azole (prochloraz, tebuconazole, epoxiconazole and prothio-desthio) sensitivity in *Zymoseptoria tritici* (*Mycosphaerella graminicola*) in the early season testing from an untreated field at Rothamsted, when compared with 2017. This is reflected in the genotyping data, with more complex CYP51 variants continuing to replace older more simple ones. The shift in azole sensitivity after treatment with an azole at AHDB fungicide performance trial sites was small in 2018. BF also reported that testing with fentin chloride (old active substance) in 2018 had also shown a shift towards reduced sensitivity, indicating an increased frequency of strains with an altered efflux pump over expression. Azole sensitivity is dynamic as shown by a stepwise development of resistance over the last 30 to 40 years of usage.

Results for SDHIs for *Z. tritici* isolates collected early season at Rothamsted showed a large shift in sensitivity in 2018 compared with 2017, after two strains with SdhC alterations first being detected at Rothamsted in 2017. Early season testing across the UK indicates that *Sdh* mutations are now widespread, at frequencies from approximately 5% through to around 40% (mainly associated with C-T79N and C-N86S mutations). Though again C-H152R was not detected early season, which seems to confirm its associated fitness penalty, and neither was C-W80S. At AHDB fungicide performance trial sites the shift in SDHI sensitivity in 2018 was marked, with isolates containing C-H152R being found at several sites post treatment with an SDHI. Two new mutations (not in combinations with other key *Sdh* mutations) were detected for the first time in 2018, in Hampshire, B-H267L and C-N86K. These have also been seen in previous laboratory mutagenesis studies and have high resistance factors. The implications for the field are unknown.

Bart showed results of SDHI cross resistance testing with *Z. tritici*. There is strong cross-resistance between penthiopyrad, bixafen, fluxapyroxad, isopyrazam and benzovindiflupyr. Fluopyram and isofetamid act differently and show a high level of cross-resistance between themselves. The cause of resistance to fluopyram and isofetamid is not known. It is not caused by a mutation in the coding region of the SdhB, C or D, which forms the SDHI binding site.

Bart showed results of ongoing work on net blotch. There was a clear varietal difference in symptom types between cv. Tower with the spotting form (*Pyrenophora teres f. maculata*) and cv. Propino with the net form (*Pyrenophora teres f. teres*). Sensitivity and genotyping showed that the *maculata* form is more sensitive to azoles and SDHI's than the *teres* form. BF suggested that FRAG guidance should now differentiate between the 2 forms as there was clearly a difference in sensitivity and the SdhC-R64 or C-K64 residue seemed also to be species-specific.

DE asked if Bart was testing any of the new chemistry expected on the market in the next couple of years. Bart said no.

JT suggested that the large shift in sensitivity seen in 2018 was likely to be a consequence of the low disease pressure.

AH asked if it is possible to model the number of generations and thus gain insight into the mutation rate in *Z. tritici*. NP suggested it would be very difficult in the emergence stage of resistance development.

7.2. NH presented results investigating the development of resistance in *Cladosporium allcinium* in oilseed rape (Velcourt/BBSRC funded)

Isolates were obtained from late season OSR and found to be insensitive to carbendazim and diethofencarb with target site mutations identified. Some isolates carried QoI target site mutations conferring resistance while target site mutations to azoles were also detected, though none of these had resistance implications. No SDHI insensitivity was detected. The work indicates that selection for fungicide resistance in non-target organisms is occurring in parallel with that observed in some target diseases. .

DE pointed out that *Cladosporium* can be a problem in cereals, causing sooty moulds. FB confirmed that this is a common problem in Scotland. AH asked if *Cladosporium* is a human pathogen, Nichola said it is not.

7.3. NP presented an update from the AHDB/industry partner project examining resistance evolving concurrently to two modes of action.

NP highlighted some currently accepted principles:

- i) restricting treatments represents a good resistance management strategy (reduces exposure and selection) and
- ii) balanced mixtures also represent a resistance management strategy (mutual protection of both MOA, combine high efficacy and low selection)

But

Restricting the total number of treatments restricts the use of mixtures and leaves one single site MOA more at risk. Experiment is designed to see if there is a middle way by exploring the effect of dose splitting (whilst complying with the maximum total dose).

In the first year of this work there was a weak impact of dose splitting on selection, which was not significant across sites. There was an impact of increasing dose on selection, but smaller than might be expected. There was an anomalous result, higher selection for SDHI insensitivity with a DMI added to a mixture of SDHI and multi-site ($P=0.007$). This could be related to selection for efflux pumps.

Despite the evidence that splitting the SDHI dose to protect the azole did not have a significant impact on selection for SDHI insensitivity, Neil indicated that the project consortium were not at this stage advocating a change in practice. More evidence is required. Sec agreed that a cautious approach to dose splitting was required as the evidence was only based on 1 years data and only looked at the shift to one MOA. Sec stated that further experimental evidence and a greater acceptance by FRAC would be required before a regulatory change could be considered.

NP highlighted a new ADAS/Manufacturers consortium project on best resistance practice in potato blight in view of the emerging strains is being developed. Expressions of interest in joining the consortium should be made to him asap.

ACTION: Expressions of interest in joining the potato blight consortium to Neil P asap

7.4. Kathryn Hales (AHDB) presented results from work commissioned by AHDB to determine fungicide sensitivity of recently emerged late blight genotypes (EU_36_A2 and EU_37_A2) present in the UK.

The work was done by JHI in response to grower concerns about tuber blight levels in potato stores despite robust fungicide programmes. AHDB presented their initial interpretation ahead of the planned formal presentation at the AHDB Agronomist Conference in December and requested feedback from FRAG_UK members.

Active substances tested were fluazinam, fluopicolide, mandipropamid, cyazofamid and propamocarb. Several manufacturers representatives questioned why more actives had not been tested. KH explained that she was new to the project so did not know the selection criteria. SK indicated that the actives tested are those with activity against tuber blight, so the selection makes sense given the concerns of growers. The work found reduced sensitivity in EU_36_A2 to several fungicide MOA. However the resistance factors were very low, the number of isolates tested was small (7 isolates of EU_36_A2, 10 isolates of EU_37_A2) and the results inconsistent between isolates. JT suggested that the EC50 range for mandipropamid was within the normal range expected and field performance would not be impacted. LC commented that propamocarb is difficult to deal with in laboratory testing and false insensitivity results are possible. NP suggested it was difficult to read too much into results on population structures and aggressiveness from 2018 due to the extreme dry weather during the growing period

Overall FRAG-UK members were uncomfortable with AHDB describing the findings as being indicative of resistance and felt the results were unlikely to explain any reduced field performance.

KH agreed to take members comments back to the research team at JHI that did the work and consult further with manufacturers before finalising the presentation for the Agronomist Conference.

ACTION: Manufacturers and PG to liaise ahead of AHDB Agronomist Conference. (post meeting note. Done)

Update on 2018 late blight genotyping

LC updated the group on the latest late blight population genotyping conducted by David Cook (JHI). DC had indicated that 2018 was an atypical year for blight as it had been unusually dry. EU_6_A1 was the main genotype, EU_36_A2 has increased in the UK from 2% of tested isolates in 2017 to 18% in 2018, EU_37_A2 had fallen from 24 % in 2017 to 17% in 2018, EU_13_A2 (Blue 13) had fallen from 11% in 2017 to 6% in 2018, approximately 10% of isolates were other genotypes. DC stated that EU_36_A2 genotype is highly aggressive making it difficult to control.

LC reminded the group that the 2019 Euroblight Workshop will be held in York in May

PG commented that AHDB were planning to set up a Potato blight resistance Working Group and invited interest from FRAG-UK members.

NP noted that ADAS were setting up a manufacturers consortium to look the best resistance management practice given the current range of blight isolates. He invited interest from relevant FRAG-UK representatives.

8. Company Resistance Updates

8.1. BASF

BM presented results from BASF 2017/18 testing. For DMI sensitivity in *M graminicola* 507 isolates from 177 samples were tested in 2017 and 652 isolates from 219 samples in 2018 across FR, UK, DE, western PL and DK. An increase in the proportion of isolates with high EC50 values was reported across N Europe. These isolates showed decreased sensitivity to both epoxiconazole and prothioconazole.

For SDHIs in 2017 the frequency of SDH adapted isolates continued to increase up from 9% of overall samples in 2017 to 28% in 2018, but mutational analysis still in progress. Despite the apparent increase in frequency of isolates with higher EC50 values, SDHI programmes were still giving good Septoria control. MT asked if BASF planned any changes to azole recommendations, BM commented that there were no immediate plans to change current practice.

8.2. 2017 sensitivity testing

BayerCrop Science

KM provided the following as a post meeting note as the BCS 2017 monitoring results had not been fully analysed in time for the previous meeting:

“KM on behalf of Bayer Crop Science indicated their monitoring had produced similar results to those already presented. In the interests of time, a summary of the results are provided below. BCS continues to use fungal isolates for sensitivity testing with the addition of mutational analysis where appropriate. In *M graminicola*, prothioconazole testing has shown a stable situation in the UK and a slightly higher sensitivity in IRE compared to previous years. This was also seen across Europe. SDHI mutations have increased in UK and IE but are still at low levels in the population. There is a slight spread of these across Europe but this is slow possibly due to a fitness penalty? No changes reported for yellow rust, brown rust or wheat powdery mildew. For barley pathogens there are no changes reported for barley powdery mildew or Rhynchosporium. There is continued concern for *Ramularia collo-cygni*. Significant sensitivity shifts to SDHI have been seen in this pathogen in UK, IRE, NL, AT, BE and North West DEU. This has also been seen for prothioconazole as an example of DMI. However some locations in the UK do not have the mutations and SDHI and/ or azoles are working well. Monitoring of net Blotch (*Pyrenophora teres*) across Europe (including samples from UK and IRE) has shown an increase in the spread of mutants with a decreased sensitivity to SDHI but the range of EC 50's have not changed.”

Corteva

MA provided the following summary of results which had not been fully analysed in time for the previous meeting

61 random *M graminicola* spore trapping samples were tested in 2017 for SDHI (penthiopyrad) sensitivity. 16 were outside the baseline, from UK, IE and DE. The four most resistant isolates (UK+IR) had resistance factors of 66-419 and all had C-H152R mutation, suggesting the

background has a strong impact on the RF.

Random Net blotch spore trapping testing showed an increasing number of isolates with elevated EC50s for SDHIs. The most insensitive isolates were found in UK and DE with a few from IE (No samples were available from France). MA announced that Dupont's former R&D function was being transferred to FMC which may limit future funding for resistance monitoring.

8.3. Update on loose smut

KM presented results from Bayer.

There were widespread reports of loose smut in winter barley in 2018, both in the UK and Germany, where fungicide seed treatments had been applied. Several barley varieties were involved. Bayer investigated 36 incidents where infection rates varied from 0.1-1%. Examination of seed showed on

average 2.9% infection, reduced to 0.21% after treatment with Raxil Star (prothioconazole, tebuconazole and fluopyram).

Glasshouse trials using seed saved from the reported cases have shown good control of loose smut following treatment with Raxil Star. However not much work has been done on sensitivity of loose smut and no baseline sensitivities exist to allow EC50s to be meaningfully looked at. It was suggested that SASA may have some wildtypes which would allow baseline testing to be done and changes to be monitored.

It is the opinion of Bayer that the outbreak was caused by ideal disease conditions, warm conditions at drilling. This has been the case for the last few years and the inoculum might have been building in the seed stock. There was a similar outbreak in Germany in 2002, the cause was not established and it disappeared again. FB reported that there has been an increase in reports of loose smut in the SRUC crop clinic over recent years, supporting the Bayer view. DE and DP (by email comment) indicated that Hutchinson's and Ayrsta have had more reports with differences between seed treatments.

JT commented that Syngenta had also noted an increased incidence of loose smut this year'

On a cautionary note NP pointed out that if a slow shift was happening this would manifest itself as an initially small reduction in control, with a build-up of disease in the seed stock.

Field testing is ongoing and BCS would hope to be able to provide an update in May. KM agreed to update members when more information becomes available.

ACTION: KM to update FRAG-UK members when further information becomes available (probably May. Ongoing).

9. Company updates

Bayer announced an authorisation for Luna Privilege (Fluopyram) in apples and pears

Certis announced an authorisation for Amylo-X (*Bacillus amyloliquefaciens* subsp. *plantarum*) on a range of vegetable crops

Belchim announced an authorisation for isofetamid

BASF announced authorisation for Integral Pro (*Bacillus amyloliquefaciens*) seed treatment on OSR

Arysta- as a post meeting note announced they were hoping to receive authorisation for fluoxastrobin on Winter OSR in time for next season

10. FRAG-UK website update

PG indicated that AHDB was in the process of building a new web-site. All the RAGs are being migrated to this site. It is a work in progress, so there may be some teething issues.

11. Liaison with other groups

No report

12. Future events and publicity

FRAG publications and Fungicide Futures publications will be promoted through the usual AHDB events

13. AOB

AH indicated that he is now only part time at Certis and therefore he proposed his place be taken by Laurence Power, Technical Manager at Certis. AH will ask LP to send his supporting statement to Sec.

MA indicated that he would be taking up a new role in Corteva who may therefore wish to change their representative. He will let Sec know.

Chlorothalonil Update: In response to a request for a update Sec (on behalf of CRD) highlighted the 4 critical areas of concern as published in the EFSA Conclusion. He indicated that this was not a favourable conclusion. No decision is likely before Christmas 2018.

14. Date and Venue of next meeting

Mike A has confirmed that Corteva will be delighted to host the next meeting at their Fulbourn office, Cambridge. **Date now confirmed as Wed 20th March.**