

1. Disease attacks in 2019

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The occurrence of diseases in the fungicide trials in 2019 is described in this chapter. Knowledge of disease occurrence is important for an evaluation of whether the target diseases were present at significant levels. Efficacy assessment trials depend on the level of disease infestation and significant attacks are often required to obtain representative results. Yield levels in cereal trials are ranked and compared with the previous years.



Wheat

Powdery mildew (*Blumeria graminis*). The sandy soil in Southern Denmark (Jyndevad) is well known for its high levels of powdery mildew infestation and, as expected, severe attacks were also observed in 2019. For the country in general, the level of mildew attacks was low to moderate. Attacks were recorded in the cultivars Torp, Kalmar, Cleveland and Ambition. Observations carried out by the advisors in the national monitoring system organised by SEGES also showed moderate attacks this year.

Septoria leaf blotch (*Zymoseptoria tritici*). The level of *Septoria tritici* attacks varied between sites and cultivars, but in general the attacks were moderate to severe. The mild winter gave good conditions for inoculum to develop an attack, but the attacks of *Septoria tritici* were delayed due to a lack of precipitation in April and cold weather in May. Precipitation increased during May, which provided better conditions for *Septoria tritici* to develop. Most cultivars showed measurable symptoms of *Septoria tritici* on the upper leaves from GS 51 in late May. Attacks on the second leaf and the flag leaf increased rapidly during June, and the significant attacks provided good opportunities for late flag leaf assessments in cultivars such as Hereford, Cleveland and Kalmar. The level of *Septoria tritici* attack assessed at GS 75 was relatively high, reaching 56% on leaf 2 and 34% on leaf 1 at GS 75.

Yellow rust (*Puccinia striiformis*). Fields with the susceptible cultivars Substance and Ambition were inoculated with yellow rust in the second week of April. The weather was windy and the cold weather in May delayed the development of yellow rust. Substance is well known for its high sus-

ceptibility and despite the cold weather in May, the attacks were moderate to severe. Ambition is in general less susceptible and this year only moderate attacks of yellow rust developed on this cultivar. In trials inoculated with yellow rust, the attacks increased to a level of 15% on the flag leaf at GS 73. An attack of yellow rust is known to reduce yields, and attacks in 2019 showed significant yield responses to fungicide treatments. Fields with Benchmark, in particular, were severely infected.

Brown rust (*Puccinia triticina*). The mild winter 2018/2019 provided good conditions for inoculum to survive the winter. Due to cold weather conditions during May, no attack of brown rust was seen in spring and early summer. In late June, a minor attack was observed in a few trials but without significant consequences for crop yields. The attack of brown rust in the cultivar Hereford (natural infection) was assessed to be low to moderate, reaching a level of 3% on leaf 1 at GS 75.

Tan spot (*Drechslera tritici repentis*). Attacks of tan spot developed in April in fields with winter wheat as the preceding crop and minimal tillage. Due to the cold weather and slow development of tan spot, no T1 treatments against tan spot were needed. During May, the infection rapidly spread to the upper leaves. Trials at Flakkebjerg, where pre-infected straw was spread in the autumn, showed severe attacks, providing optimum conditions for efficacy evaluations. Field trials at Flakkebjerg were established in the cultivar Graham, which is susceptible to tan spot. During May and June, the attacks of tan spot increased and severe attacks were assessed at all leaves during the growing season. At GS 73, the disease level increased to 53% on the flag leaf and 93% on leaf 2.

Fusarium head blight (*Fusarium* spp.). To ensure that *Fusarium* was established at an assessable level, all *Fusarium* trials were inoculated. Inoculation combined with irrigation during flowering almost always lead to visible attacks. Daily irrigation was installed in small plots where cultivars were tested for susceptibility. The moist conditions in these trials ensured a severe attack of *Fusarium*, allowing for an assessment of the level of susceptibility of the cultivars. In the large plots, the winter wheat crop were inoculated during flowering and irrigated 1-2 times during the same period. Due to the optimal weather conditions during flowering, the attacks in inoculated field trials were severe and gave good opportunities for detecting differences in fungicide performance.



Triticale and rye

Yellow rust (*Puccinia striiformis*). A severe attack of yellow rust developed in the triticale trials in 2019. The triticale trials were naturally infected and the infestation levels on the flag leaf increased to 61% at GS 71. The disease level gave good opportunities for ranking the performances of the fungicide products.



Brown rust (*Puccinia recondita*) appeared in winter rye with a severe attack late in the season. Despite the late incidence of attack, good opportunities for ranking the performances of the products were present. At GS 77, the attack increased to 75% on leaf 2 and 34% on the flag leaf.



Rhynchosporium (*Rhynchosporium commune*). A moderate attack of *Rhynchosporium* developed early in the winter rye trials in 2019. The disease level provided relatively good opportunities for ranking the performances of the products. The attack of *Rhynchosporium* in rye increased to 10% on the upper leaves at GS 77.

Winter barley

Powdery mildew (*Blumeria graminis*). A minor attack of mildew developed in the cultivar Matros during the growing season; due to the low level of attack, the opportunities for ranking the performances of the products were limited.

Brown rust (*Puccinia hordei*). Brown rust was the prevalent disease in winter barley in 2019. From early spring, this disease was present at most sites and in most cultivars. In the field trial, Kosmos, Memento and Celtic developed severe attacks, which gave good opportunities for ranking the efficacy of the different fungicides in 2019. The average attack of brown rust in this year's trial at AU reached a level of 32% on leaf 2 at GS 71-75.

Rhynchosporium (*Rhynchosporium commune*). In general, the level of *Rhynchosporium* attack in winter barley was low in 2019. A minor attack of *Rhynchosporium* developed in the cultivar Frigg but the year provided only limited opportunities for ranking the performance of products. The average attack of *Rhynchosporium* reached a level of 3% at GS 71-75.

Net blotch (*Drechslera teres*). A minor to moderate attack of net blotch developed during the season in winter barley trials in the cultivar Celtic. Opportunities for ranking fungicide performances were limited. In trials with net blotch, the average attack in the susceptible cultivars reached a level of 5% on leaf 2 at GS 71-75.

Ramularia leaf spot (*Ramularia collo-cygni*). In general, attacks of *Ramularia* developed late in the season and few cultivars showed assessable symptoms of *Ramularia*. Trials in the cultivars Kosmos,

Memento and Celtic developed moderate to severe attacks. In specific *Ramularia* trials, the average attack reached a level of 30% on the flag leaf and 50% on leaf 2 at GS 73-77. The severe attack of *Ramularia* gave good opportunities for ranking fungicide performances.

Spring barley

Powdery mildew (*Blumeria graminis*). The attacks in 2019 were limited to the cultivar Milford, which does not carry mlo resistance. Attacks in trials with attack of mildew provided possibilities for ranking the performances of fungicide products. Attacks of powdery mildew reached a level of 10% at GS 57-65 on leaves 2-3.

Net blotch (*Drechslera teres*) was common in fields in 2019. In general, attacks were moderate to high and in some susceptible cultivars, the attacks of net blotch were assessed as severe. In 2019, both Chapeau and Laurikka developed moderate to severe attacks. In the trials, both cultivars provided good possibilities for ranking the performances of the fungicides. Attacks of net blotch in Chapeau and Laurikka reached an average level of 27% on leaf 2 at GS 73-75.



Brown rust (*Puccinia hordei*). In all trials, severe attacks developed in 2019 and in particular in the cultivars Chapeau, Milford, KWS Irina and Laurikka. This provided a good opportunity for ranking fungicide performances. The attack at Flakkebjerg reached an average level of 30% on leaf 2 at GS 73-77.

Ramularia leaf spot (*Ramularia collo-cygni*). *Ramularia* was present in the cultivars Chapeau, Milford and KWS Irina in 2019. *Ramularia* developed late in the season. In the trials, all cultivars provided good opportunities for ranking the performances of the products. The attack of *Ramularia* reached an average level of 24% on leaf 2 at GS 73-77.



Yield increases in fungicide trials in cereals

Harvest conditions were good in 2019. In general, the harvest of winter barley was carried out without problems and high quality harvest products were sampled during July. Winter barley trials were irrigated once in May and showed fine performances due to sufficient precipitation during the growing season. The winter barley wilted a bit early due to high infection of brown rust. Yields reached 60-85 dt/ha. The general yield response was high for winter barley. The severe attack of especially brown rust was the reason for the yield increases. Standard treatments yielded an average increase of 11.6 dt/ha.

The weather in August was more inconsistent as regards precipitation but most trial samples were of good quality. The winter wheat trials generally yielded well due to a good response to the fungicide treatments and sufficient precipitation. Winter wheat trials yielded in the range of 70-120 dt/ha with an average yield of 90 dt/ha. Yield increases following fungicide treatments in winter wheat were significant and most trials and fungicide treatments were profitable (Table 1). Even for Informer, which was the most resistant cultivar, a yield increase of more than 10 dt/ha was recorded.

Spring barley developed well during the season and no irrigation was required. A short period with very high temperatures did, however, stop crop growth earlier than expected due to fast senescence. This had an impact on the yield levels, which stayed moderate around 60-70 dt/ha. The yield response to fungicides in spring barley was also significant. The early severe attack of particularly net blotch and brown rust in spring barley gave significant yield responses in the trials. Standard treatments in spring barley resulted in an yield increase of 14.3 dt/ha.

Table 1. Yield increases (dt/ha) for disease control in fungicide trials. The results are from the reference treatments which typically are two treatments per season. Numbers in brackets indicate the number of trials. Data originate from SEGES and AU Flakkebjerg trials.

Year	Winter wheat	Spring barley	Winter barley
2005	6.4 (126)	5.4 (43)	4.6 (60)
2006	8.0 (106)	3.3 (63)	5.1 (58)
2007	8.5 (78)	7.2 (26)	8.9 (13)
2008	2.5 (172)	3.1 (29)	3.2 (36)
2009	6.3 (125)	5.1 (54)	6.3 (44)
2010	6.6 (149)	5.6 (32)	5.9 (34)
2011	7.8 (204)	3.9 (43)	4.3 (37)
2012	10.5 (182)	6.7 (38)	5.1 (32)
2013	10.3 (79)	5.2 (35)	5.5 (27)
2014	12.0 (82)	3.0 (19)	4.1 (18)
2015	10.9 (73 SEGES + 29 AU)	9.1 (20)	7.3 (19)
2016	10.9 (59 SEGES + 34 AU)	8.0 (16 SEGES + 13 AU)	4.0 (11 SEGES + 10 AU)
2017	15.0 (94 SEGES + 55 AU)	10.4 (11 SEGES + 16 AU)	11.9 (11 SEGES + 14 AU)
2018	4.3 (24 SEGES + 21 AU)	3.6 (4 SEGES + 12 AU)	7.5 (2 SEGES + 12 AU)
2019	15.4 (28 SEGES + 24 AU)	11.6 (10 SEGES + 9 AU)	11.5 (6 SEGES + 6 AU)

Maize

Eye spot (*Kabatielle zeae*). Minor and insignificant attacks of eye spot developed in the trials during the season. Attacks increased slowly during the summer, but due to the low level of the attack, the assessments gave poor opportunities for distinguishing between the performance of the products. The attacks on the lower leaves never increased above 17%. The attacks on the upper leaves increased to 8% in late September but had no significant effects on yield parameters.



Sugar beet

The season was very conducive to attacks of particularly mildew (*Erysiphe betae*) and rust (*Uromyces betae*). In September, also minor attacks of *Ramularia betae* and *Cercospora beticola* were found in the trials. Clear differences between treatments could be seen from drone photos taken late in the season.



Grass seed - ryegrass

A moderate attack of crown rust developed in ryegrass. The attack was well controlled by one treatment. No rust attacks developed during the summer season in *Poa pratensis*, where rust first appeared in the autumn. Trials with red fescue showed attacks of leaf spot diseases, but these symptoms were not controlled by spraying.

