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THE USE OF METEOROLOGICAL AND FIELD SPECIFIC PARAMETERS TO PREDICT THE EVOLUTION OF PESTS AND DISEASES IN WINTER WHEAT: AN ANALYSIS OF THE EPIPRE-DATABASE

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SUMMARY

EPIPRE, an acronym for EPIdemic PREdiction and PREvention, is an integrated pest and disease management system for spring and winter wheat based on calculations of costs and benefits of pesticide treatments. EPIPRE, a computer-based advisory system, advises on the necessity of spraying against the following pests and diseases in winter wheat: Eyespot *(Pseudocercosporella herpotrichoides)*, powdery mildew (*Erysyphe graminis*), stripe rust (*Puccinia striiformis*), leaf rust (*Puccinia recondita*), leaf blotch *(Mycosphaerella graminicola/ Septoria tritici)*, glume blotch *(Lepthosphaeria nodorum)* and aphids (*Sitobion avenae*, *Metopolophium dirhodum* and *Rhopalosiphum padi*).

The calculation of the expected yield loss (the potential benefit) is based on disease and pest observations, field specific parameters as for example variety, soil type, sowing date,.. and meteorological data. The user-friendly database structure of more than 6800 field observations and EPIPRE-recommendations during the last two years (1993 and 1994) makes it possible to examine the existence of relationships between field observations and meteorological parameters, between field observations and field specific parameters.

In this article we will compare the evolution of leaf blotch and eyespot during the last two seasons 1993 and 1994, which where extremely different from meteorological point of view. The analysis is based on more than 6800 field observations, collected by the EPIPRE-advisory system on more than 1200 different wheat fields in Belgium and the North of France. This article will not only discuss the evolution of the several pests and diseases during the growth season in general, but also on the level of varieties and more field specific parameters.

DATA COLLECTION

Sampling procedure

In order to predict the expected yield loss of the crop, EPIPRE uses the actual and field specific pest and disease incidences. This information is provided by the participating farmers who are trained to recognise and to distinguish between the most important cereal diseases.

Table 1 gives a brief overview of the several pests and diseases to count by the farmer at well described growth stages.

Table 1: Overview of the crop development stages during which counts of the several pests and diseases are to be made

	Growth Stage (GS)							
pest/disease	30 Pseudo stem erection	32 Second node detectable	39 Flag leaf visible	43 Early boot	69 Anthesis complete	77 Late milk	Sampling unit	Sample size
Eyespot							base of tiller	40
Stripe rust							all green leaves	200[1]
Brown leaf rust							all green leaves	200[1]
Powdery mildew							three leaves on top	120
Leaf blotch							three leaves on top	120
Aphids							culm	100

1. Maximum number

Table 1 indicates which pest and disease assessments must be made at a certain development stage of the crop. The table gives also information about the nature of the sample. The plant samples are being taken by hazard in the field following a well described sampling method to avoid biased observations. Plants should be collected in a part of the field which can represent the disease incidence of the whole field. This means for instance that one has to avoid to sample plants in the borders of the field, the places in the field used for temporary crop storage, fertiliser storage,...
For instance at Growth Stage (GS) 31, first node detectable, the farmer needs to count the number of tillers with eyespot infection and the number of leaves with powdery mildew, leaf rust and stripe rust. Normally it takes about 20 minutes to make the assessments because in the field it is rather an exception that all the diseases that could be present at a certain growth stage actual also are present.

The follow up of an EPIPRE-field during the season

The first disease assessment is made during the period 'Growth Stage 30 or end tillering - Growth Stage 32, second node detectable'. Normally a farmer makes about 5 field observations during one season. The period between two observations is not a fixed number of days but depends on the development stage of the crop, the size of the present pest and diseases and possible preceding chemical treatments. For instance when the predicted yield loss almost exceeds the total spraying cost the recommendation not to spray is accompanied by a request to make a new observation within 8 days instead of the more common period of 14 days. Thanks to this detailed monitoring it will be possible to attain the maximal financial benefit of the crop without taking unnecessary risks.

An overview of the measured and average rainfall during the season 1992-1993 and 1993-1994

Figure 1 gives an overview of the actual measured rainfall and the average rainfall during the last two seasons. The first season was characterised by a very dry period which started in February and lasted until April. The second season on the contrary was characterised by an extremely wet period during the months December and January.

RESULTS

Leaf blotch

The presence of leaf blotch at growth stage 39, flag leave just visible

Figure 2A and 2B indicate that the presence of leaf blotch on the upper three leaves at growth stage 39 is being influenced by the rainfall during winter and early spring.
In 1993 the relative absence of rain in the beginning of the season, starting at growth stage 30 or tillering (February) until growthstage first/second node detectable (May), controlled on many fields the spread of leaf blotch.

In 1994 on the contrary the abundant rainfall during the winter caused an almost explosive spread of leaf blotch which lead to the presence of leaf blotch on 78 % of the fields at growth stage 39.

The evolution of leaf blotch during the season at several growth stages

Figure 2A and 2B show the presence and evolution of leaf blotch during the season on the upper three leaves. At growth stage 39 leaf blotch was absent on 46 % of the fields in 1993. In 1994 this was only the case on 22 % of the fields.

Comparing the field observations of these two years, carried out by the participating farmers during anthesis, indicates that in 1993 even at this late stage we observed the presence of leaf blotch on only 23 % of the fields. This was an extremely healthy situation. Field trials confirmed that in
Fig. 1

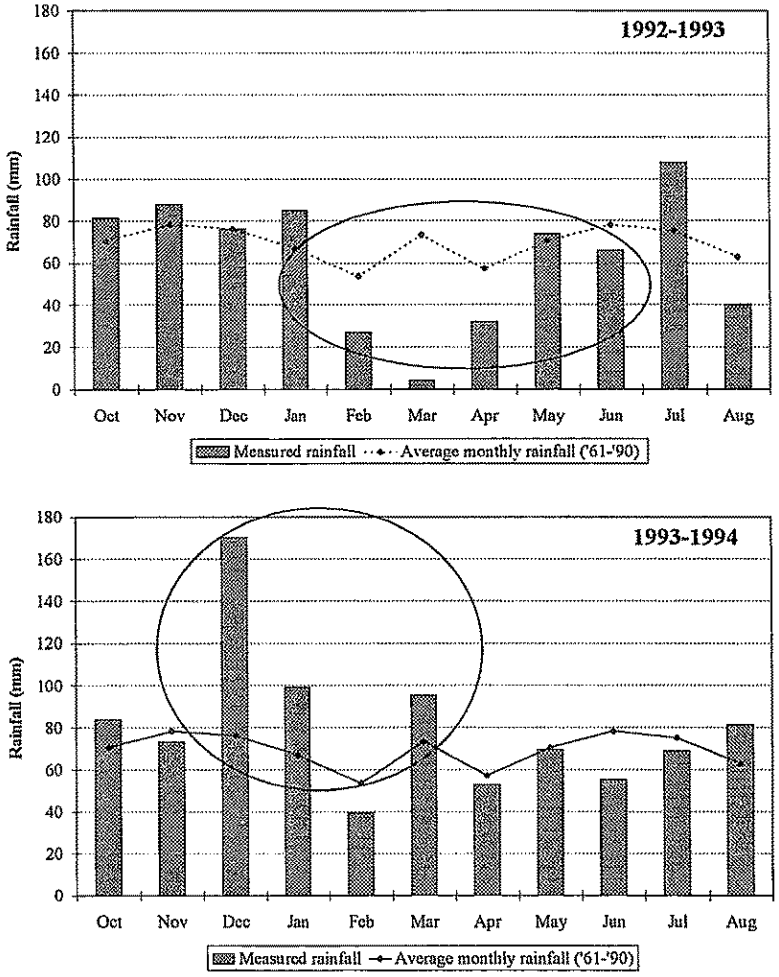

Figure 1 : Measured and average rainfall during the season 1992-1993 and 1993-1994 (Source: KMI Ukkel-Belgium)

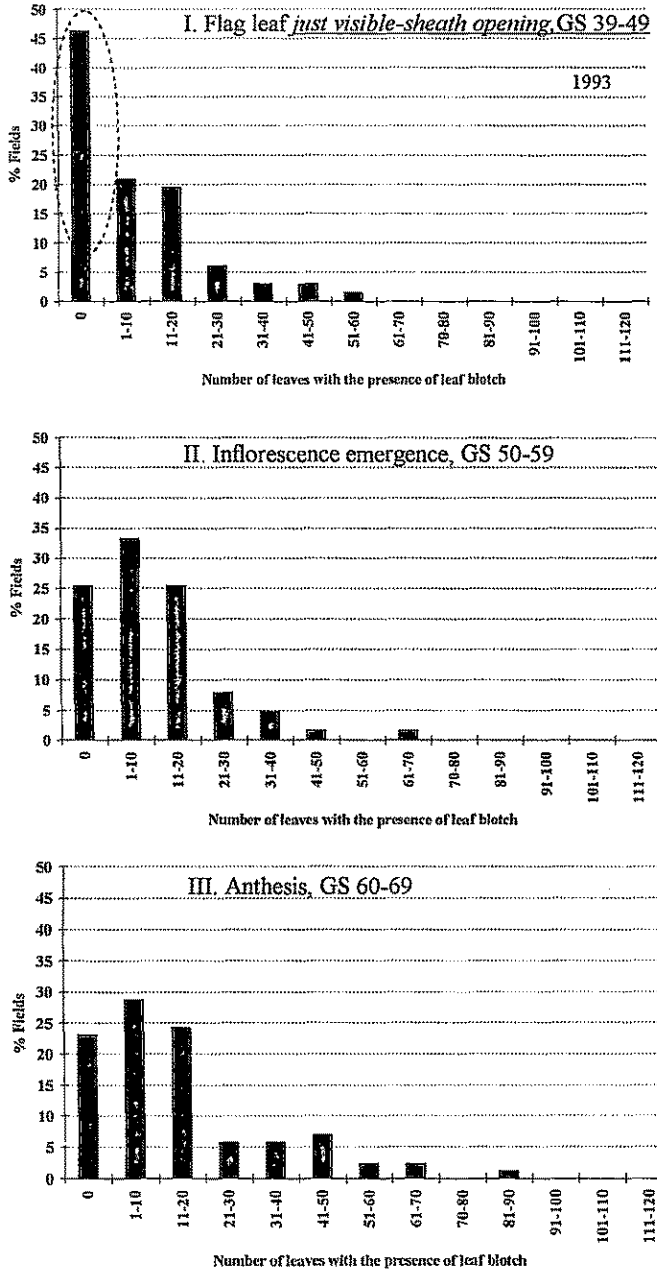

Figure 2 A : The relative frequency of leaf blotch at several growth stages in Belgium in 1993

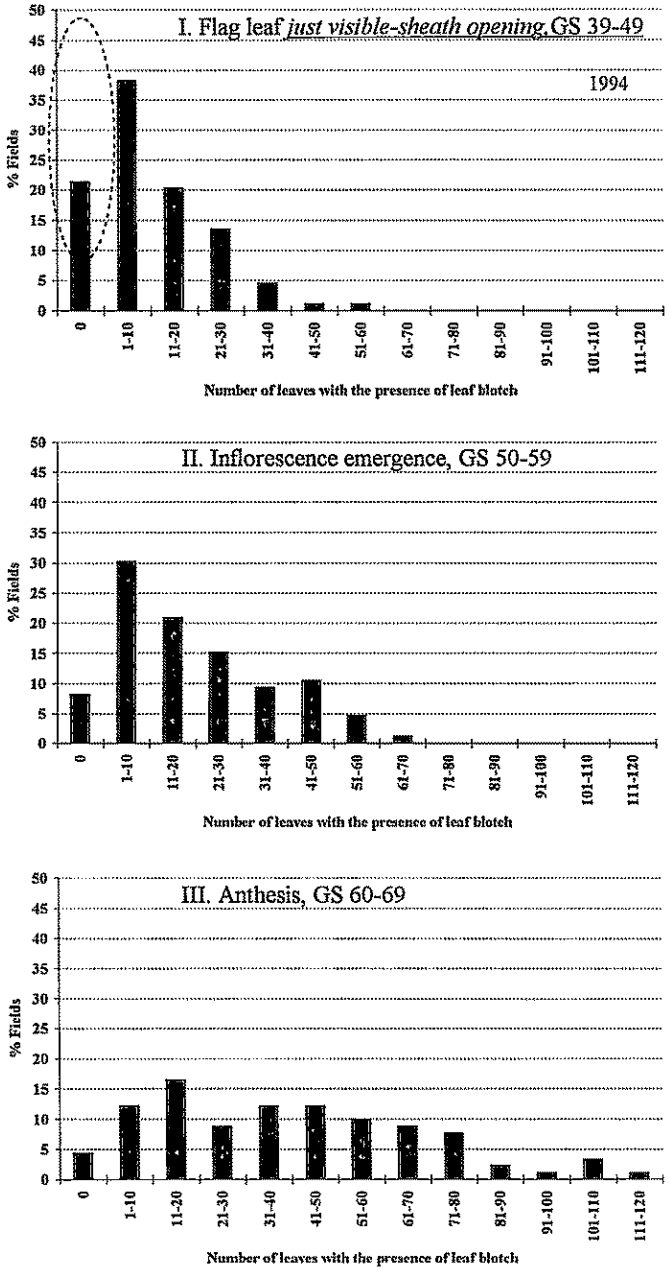

Figure 2 B : The relative frequency of leaf blotch at several growth stages in Belgium in 1994

those cases with a similar weak presence of leaf blotch and the absence of brown rust further on during the season, the best financial results can be obtained without the use of any chemical treatment.

Eyespot

The relative frequency of eyespot at growth stage second node detectable

Figure 3 shows the relative frequency of eyespot at growth stage second node detectable for the variety Ritmo. In 1994 there were more fields with a low number of infected plants in the beginning of the season. This may be the consequence of the dry and warm period in the early spring of 1993 during which the progress of eyespot was blocked or sometimes stopped on many fields.
Even for one and the same variety we see that the distribution of the relative frequency of eyespot is relatively flat. Knowledge about the sensibility of the variety for a certain disease is not enough to decide whether or not a chemical control is necessary. Apparently other factors must be taken into account in order to explain this variation.

The influence of field specific parameters on the presence of eyespot

Further investigation of the EPIPRE-database showed the existence of a strong relationship between the sowing date and the number of fields which received a spraying advice against eyespot. The average number of plants with the presence of eyespot and a sowing date before the 15th of October (242 fields) was almost twice the average of the plants with the 25 th of October (268 fields).

Not only the factor variety and sowing date should be taken into account, also the previous crop and crop rotation influences in a very important way the presence of eyespot. The analyses for 129 fields with the variety Soissons indicates that growing wheat after wheat leads to a high risk situation. The average percentage of plants with eyespot in this narrow crop rotation was about 20 %. For information: EPIPRE was giving a spraying advice on 50 % of the fields with the previous crop wheat. The average percentage of infected plants on those fields was 28%.

The risk was less after other crops. After peas 11 % of the plants were infected with eyespot (on average); after rapeseed 11 %, after maize 10 %, after beets 7 %. Although this average infection rate was less high, this does not mean that growing wheat after these crops excludes all risks. After peas for instance it was necessary to give a spraying advice on 25 % of the fields, the average percentage of infected plants on these fields was about 26 %.

CONCLUSION

The analyses of more than 6800 field observations gives evidence for the existence of strong relationships between the observation of pests and diseases in the field and both meteorological and field specific parameters.

Although there's no doubt about the strong relationship between the evolution of pests or diseases and meteorological parameters, field specific parameters like sowing date, previous crop, soil type,... determine the optimal period of chemical control. Only a field specific approach can lead to a maximal financial result.

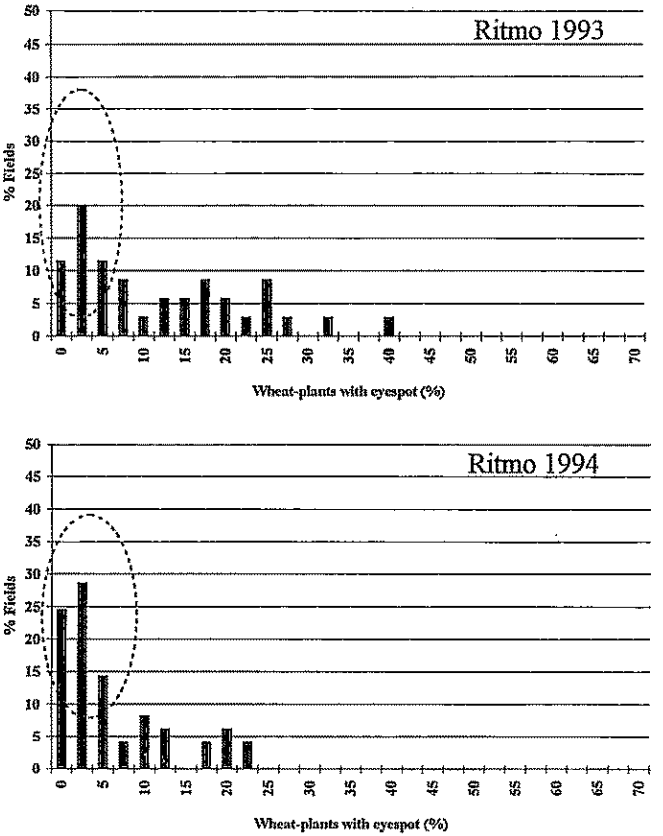

Figure 3 : The relative frequency of eyespot at growth stage second node detectable in 1993 and 1994, variety Ritmo.