A SURVEY OF WHEAT TAKE-ALL IN BELGIUM

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SUMMARY

Take-all of wheat caused by the soil-borne fungus Gaeumannomyces graminis var. Tritici (Ggt) is known world-wide as a major yield-limiting factor. In Belgium, the Take-all disease is not very well known. A take-all survey has been set up in 1999 in Belgium in collaboration between the Agricultural University of Gembloux and Monsanto where goals were to quantify the disease in the main cereal areas and to study the main factors influencing take-all development.

INTRODUCTION

Take-all is a wheat soil-borne disease due to the fungus Gaeumannomyces graminis var. tritici. This disease can cause important damage and yield losses in wheat crops when climatic and growing conditions are favorable.

Take-all is well known in France and in the United Kingdom, mainly in areas where wheat is growing in monoculture or in rotations with some wheat crops are subsequent.

Recent surveys have shown that take-all is also present in other European countries, especially in areas of intensive wheat production.

The introduction of effective chemical controls of this disease by fungicide applied in seed treatment (Beale and al, 1998; Löchel and al, 1998) is the occasion to evaluate the level of take-all infestation on wheat crops in the main cereals areas of Belgium and study some growing conditions where the risks are important.

During the season 1998-1999, a large survey of take-all was made in collaboration between the Agricultural University of Gembloux and Monsanto.

MATERIALS AND METHODS

During June and July 1999, plants were sampled in 268 different growing conditions. These 268 fields were taken in 150 different farms in the main cereals areas of Belgium (Région limoneuse, région sablolimoneuse, Condroz and Polders).

These plots are mainly situations where the rotational risk, as defined by Becker and al. (1998), was high (wheat as previous crop) but also situations with other caracteristics as previous crop or rotation. In some cases, plots with high risk and plots with other growing conditions are adjacent and a comparison of the infestation levels are made.

For each plot, 50 plants were sampled systematically between anthesis and harvest. Only roots and stem basis were keeped and stocked in cold room.
The root samples were washed thoroughly to remove any ramaining soil and the percentage of root area affected with take-all root rot was assesed visually.
The proportion of root system with symptoms was scored with a seventeen –class severity scale (0,2,5,10,15,20,25,30,35,40,45,50,60,70,80,90 and 100 % of the root system infected = P).
With these observations, two index were calculated:

- The frequency of infestation (FI) according to the formula:
  FI = number of plants infested/total number of plants scored

- A weighted take-all index (TAI) according to the formula:
  TAI= Σ Pi x Ni/N where Pi= percentage of i class
  Ni= number of plants in i class
  N= total number of plants scored

RESULTS AND DISCUSSION

Effect of the sampling date

Sample were made during a long period from beginning of June until the end of July, from GS51 until 85. The level of infection increases along this period (Fg 1 and 2).
The differend trend curves in figures are calculated with Excel^{Tm}: it is a linear regression.

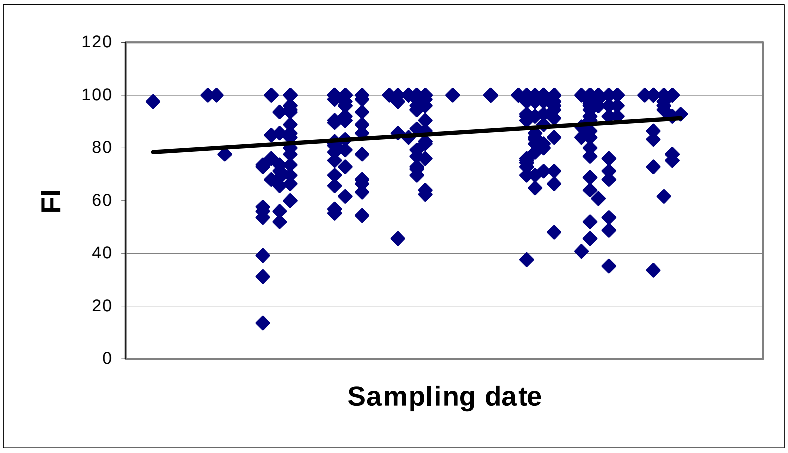


Figure 1: FI evolution during the sampling period.

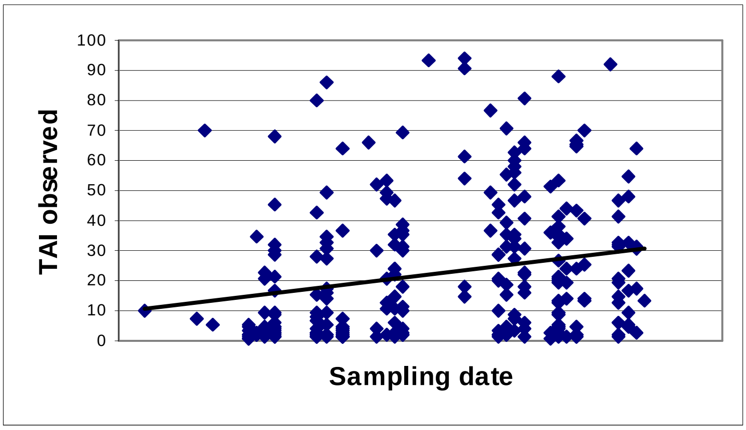


Figure 2: TAI evolution during the sampling period.

In four plots, the survey was made at 4 moments to study the cinetic of disease development. As the evolutions are quite different in each four situations, it was not possible to establish a mean evolution curve.

Nevertheless, to limit the incidence of sampling date, the whole of the observations are divided into three groups, corresponding to 3 sampling periods, separated by two breaks due to the time needed to score plants.

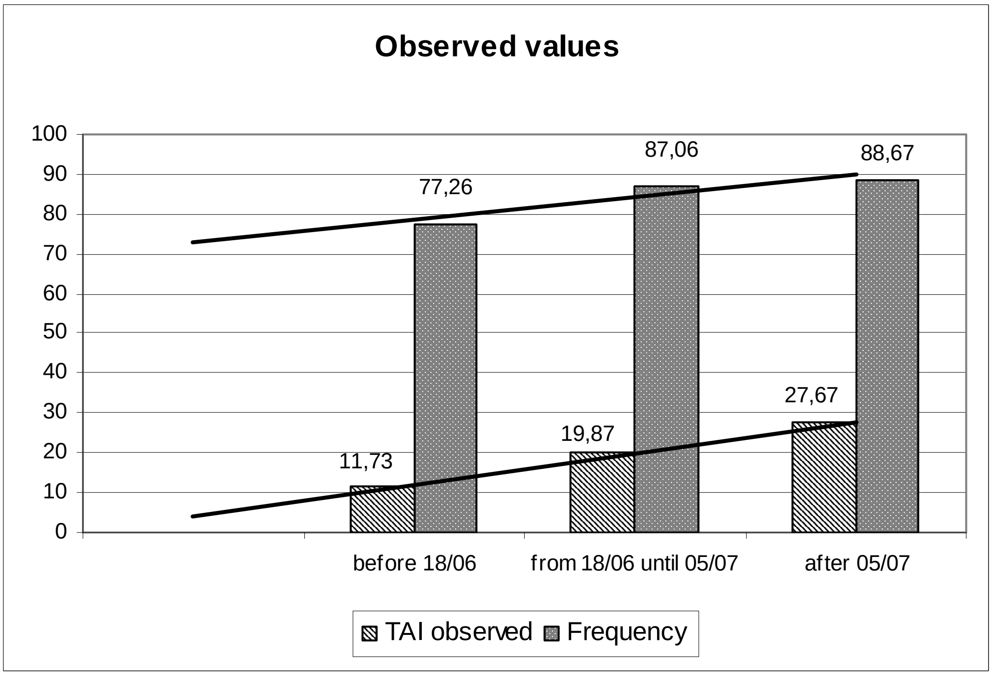


Figure 3: Evolution of TAI and FI according the three periods of sampling

The breakdown of the samples into these three periods can show the increase during the season of the TAI level.

To reduce the incidence of the sampling date on TAI, data was modified as if all the plots were sampled at the last period. All the values of TAI from the first group (observation before 18/6) were added of 16 and those of the second group (observations between 18/6 and

5/7 were added of 8. These corrections seem to reduce the influence of the sampling date on TAI, as shown in figure 4, where the regression line will be nearly horizontal.

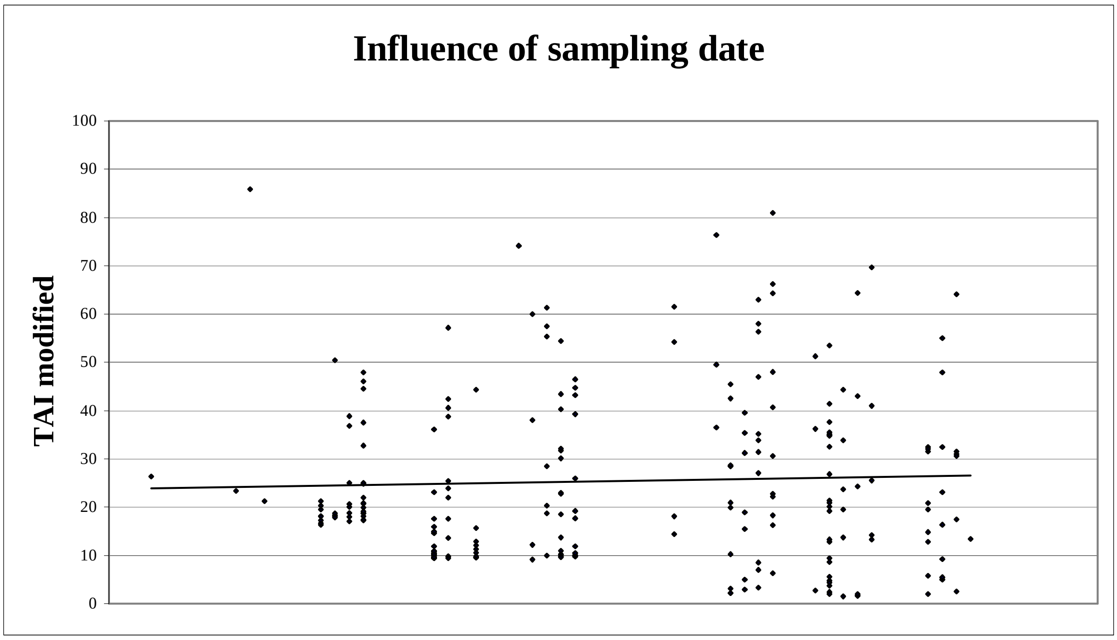
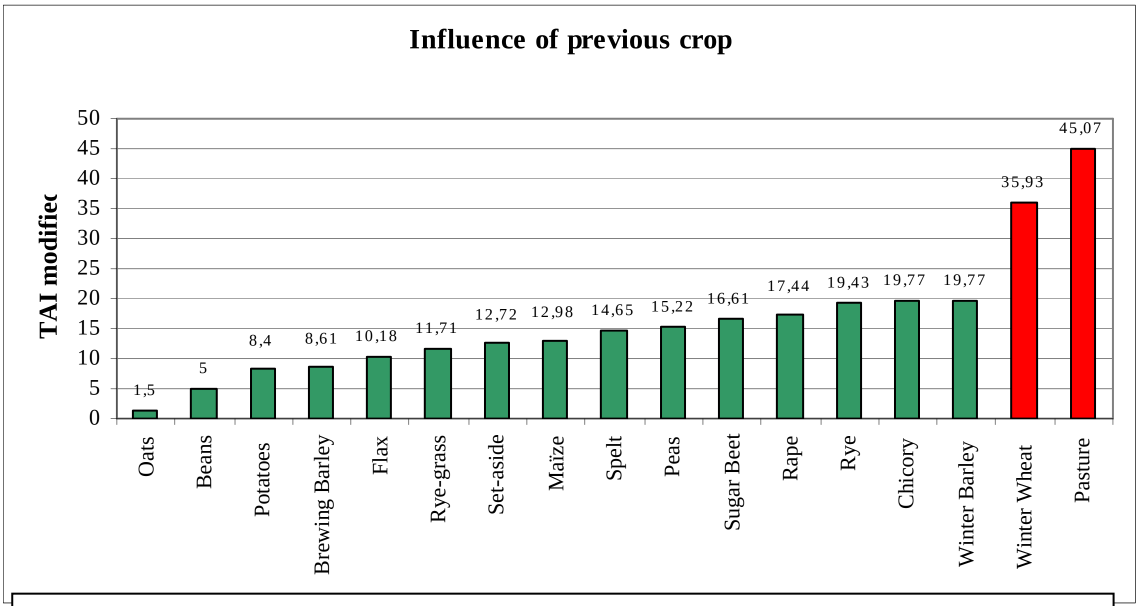


Figure 4: General view of TAI after data transformation

For result discussion, analysis was only made on TAI; the values of TAI will be the modified values as the methodology described before.
The FI levels observed were always high and did not allow to safely identify the growing conditions where take-all risks are very important.

Previous crop effect

In the figure 5, it appears clearly that as previous crop wheat and pasture are favorable to a higher level of infection by take-all. With other crops, TAI is lower and any difference can be made between them. Often presented as a previous crop increasing the infection risk (Becker and al, 1998), winter barley give in this survey a moderate level of TAI, but with only two plots.



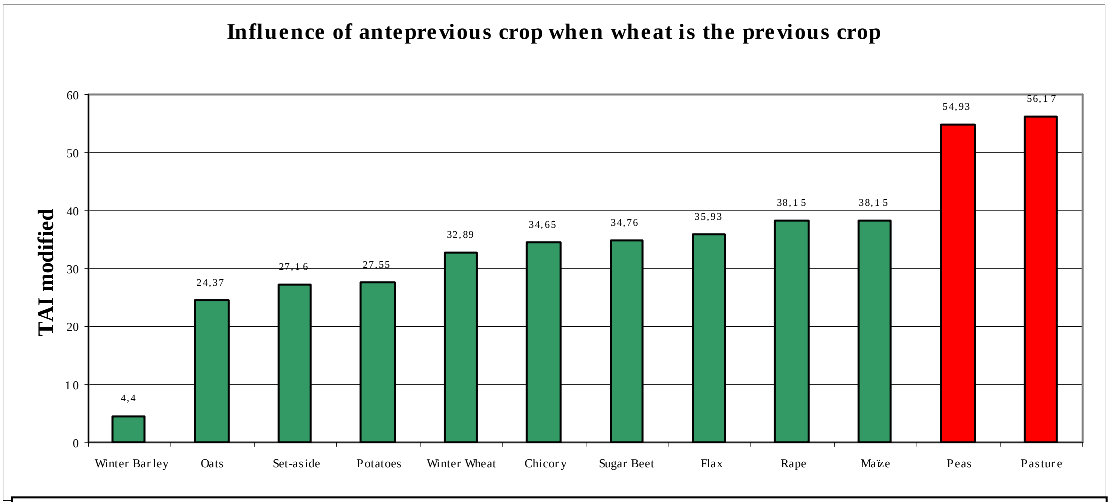
n plots =	1	1	2	1	2	10	8	56	1	3	10	2	2	2	2	132	3

Figure 5: Mean TAI by types of previous crops.

Ante-previous crop effect

After have shown the importance of wheat as a previous crop on the disease level, it is interesting to look after the eventual incidence of the ante-previous crop.

In a first step , we have regrouped the plots with wheat as a previous crop according to their ante-previous crop (figure 6). Only two crops , pasture and peas have a TAI higher than other ante –previous crops. Wheat and maize do not seem more favorable than many other crops.



n plots = 1	4	4	4	14	2	64	5	4	18	3	3

Figure 6: Effect on TAI of the ante-previous crop in plots with wheat as previous crop.

In a second step, we can look after the eventual incidence of wheat as an ante-previous crop in the plots where the previous crop is not a wheat. In the figure 7 where the previous crop is a maize, effect of type of ante-previous crop does not appear; wheat as an anteprevious crop gives any increase in the infection level. Thus, the take-all risk is still maximum the second year in a succession of wheat crop.

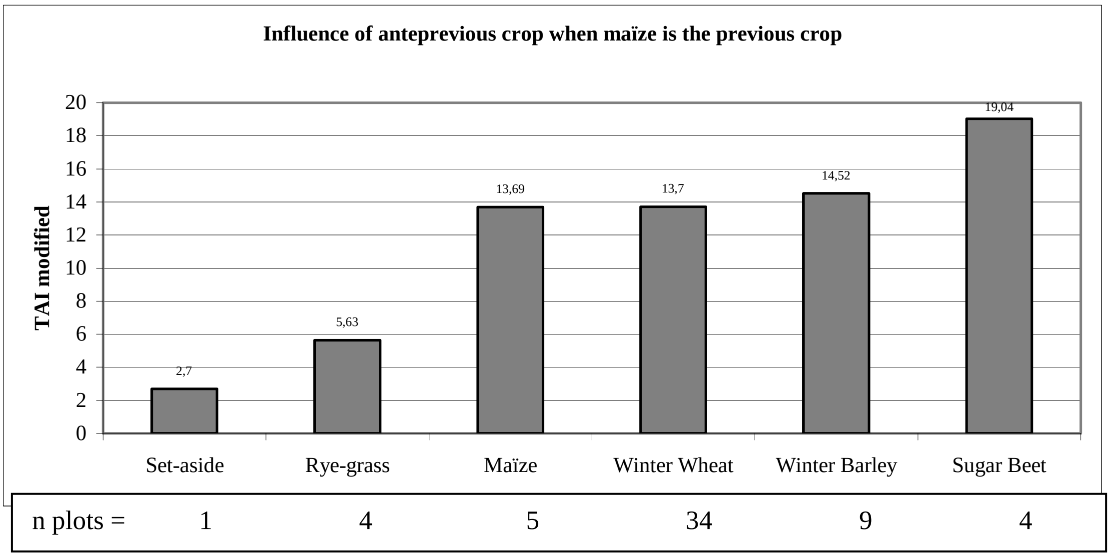


Figure 7: Effect on TAI according to the anteprevious crop in plots with maize as previous crop.

A third step was seing the incidence of the crop placed between two wheat crops: W/ ?/W (figure 8). Wheat is in this case the only crop with a higher TAI. Maize, barley, ray-grass, set aside are not more favorable than crops such sugar beet, chicory or peas and rapeseed.
All these results show that the role of the ante previous crop is secondary and that only one year of break crop is enough to limit the risk of take –all disease in a succession of wheat crops.

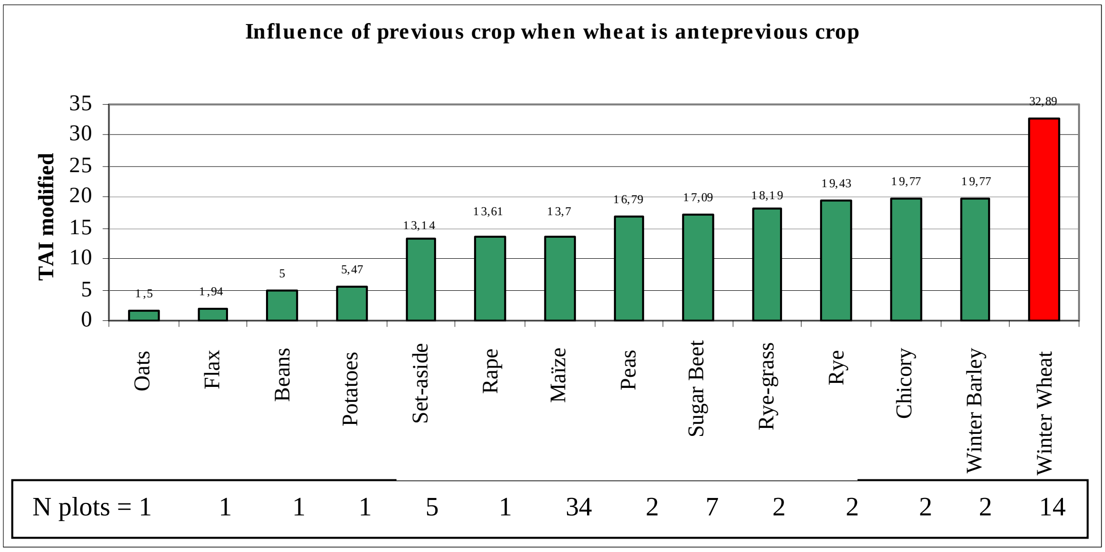


Figure 8: Effect on TAI according to the previous crop with wheat as anteprevious crop.

Wheat monoculture effect

When the plots are regrouped according to their number of subsequent wheat crops, high TAI appear with two or three subsequent wheats; we can also observe a decline in the infection level with a longer monoculture (table 1).

Wheat sequences	**n**	**TAI modified**
W / W	108	36
W / W / W	10	43
W / W / W / W	4	29
W / W / W / W / W	1	23
W / W / W / W / W / W	1	15

Table 1: Means of TAI for different sequences of wheat

This trend, based on a small number of observations, is similar to the results reported by many authors such as Lemaire and Coppenet (1968), Colbach and Huet (1995)

Pasture influence

If pasture was present in the plots less than fifteen years ago, the disease level is higher, but not so much as pasture is previous crop.

Others influences

The survey has showed some other trends:

- When the drainage of plots is bad, the TAI is rising up
- Gramineous weeds, mainly couch-grass and windgrass, in the crop increase TAI
- Early date of sowing is also favorable to the disease development

Some factors do not have effects: any differences appears between varieties and agricultural areas.

CONCLUSION

This survey, made during only one growing season, has shown that take-all is present in Belgium but the risk is mainly in crops where wheat or pasture are previous crop.

The anteprevious crop do not have influence, except if it is pasture.

A break of only one year between two wheat crops is suffisant to have again a disease level similar as this of a first year of wheat.

Early date of sowing, bad drainage and gramineous weeds in the crop are secondary factors increasing slightly the disease level.

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