Clubroot Disease in Rapeseed – A Persistent Challenge thanks to Varying Pathotypes

Benedikt Flecke[1], Johan De Dobbelaere[2], Michaela Wille[1], Becke Strehlow[3], Stephan Pleines[1]

[1]*Syngenta Seeds GmbH, Germany* - [2]*Syngenta ICS Commercial Unit, Belgium* – [3]*University of Rostock, Germany*

ABSTRACT

Clubroot, caused by *Plasmodiophora brassicae*, is an important disease of *Brassica* crops in Europe. Resistance breeding is a powerful tool to control the disease. Due to ongoing spreading, monitoring of clubroot occurrence becomes very important. During the last years, increasing incidence for resistance breaks were determined. Adapting differential sets for pathotypes will enable for more precise identification.

CHALLENGES FOR RESISTANCE BREEDING IN EUROPE

CLUBROOT AT A GLANCE

- Pathogen: *Plasmodiophora brassicae*
- Symptoms: Root thickening and subsequent gall formation
- Soil-borne disease of high importance for *Brasssica* crops
- Prevalent on every continent
- Virulence of pathotypes differs against varying host plants
- Resistance breeding is a strong option for disease control

In Europe, high incidence of clubroot is noted in Central Europe, including Poland, Germany, France and Czech Republic. Infection causes yield reduction of 50 % and more. Introduction of clubroot resistant rapeseed *cv. Mendel* to the European market in 2000 helped farmers to cultivate rapeseed even on infested fields. Today's new clubroot-resistant varieties possess better seed yield and agronomic characteristics and demonstrate the potential of plant breeding for a better control of the disease. Almost all commercial clubroot resistant rapeseed varieties carry the *Mendel*-resistance.

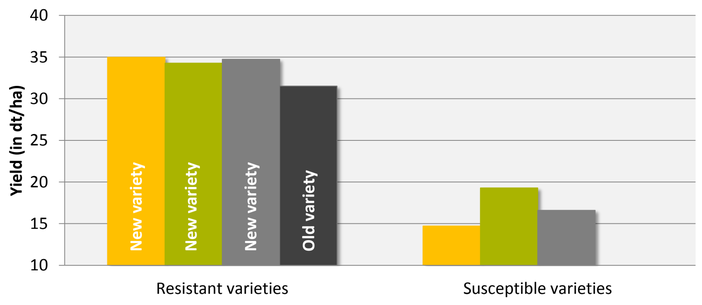

Fig. 1: Seed yield of resistant and susceptible varieties on clubroot infested soil

P. brassicae possesses 8 different pathotypes (according to Somé *et al.* 1996). Resistance of *Mendel* is successful against P1, P2, P3 and P5. Cultivation of rising acreages of resistant varieties disclose increasing resistance breaks in Europe (Zamani-Noor 2015). For successful breeding, monitoring and pathotype identification of *P. brassicae* is of high value.

MATERIALS & METHOD

Experiment 1: Monitoring of clubroot spreading

Farmers in Germany, Poland and Czech Republic took soil sample from their fields. At University of Rostock the bioassay was conducted under greenhouse conditions on 35 seedlings of susceptible *B. napus* (*cv. Visby)* used for each soil sample. Control plants were transplanted into pots filled with soil mix without resting spores. Symptoms were assessed after 6 weeks. Disease rating was recorded on a scale from 0 to 3, with 0 = no disease and 3 = main root heavily clubbed.

Experiment 2: Pathotype identification

Due to specific host-pathogen interaction it is possible to classify pathotypes. For pathotype identification, clubs of a resistant variety collected in South Germany were examined. From each club one pathogen suspension was produced. According to Somé *et al.* 1996, *B. napus* cvs. *Nevin*, *Wilhelmsburger* and *Brutor* were infected to identify the prevalent pathotype.

Variety	P1	P2	P3	P4	P5	P6	P7	P8
Nevin	●	●	○	○	○	●	○	●
Wilhelmsburger	●	○	○	○	●	○	●	●
Brutor	●	●	●	○	●	○	○	○

○ resistant ● susceptible

Tab. 1: Pathotype identification according to Somé *et al.* 1996

For control pathotype identification with *Mendel*-resistance and susceptible *cv. Visby* was also conducted. Disease rating was recorded on a scale from 0 to 5, with 0 = no disease and 5 = main root heavily clubbed. Disease Index (DI) was determined by:

$$DI\ (\%) = \Sigma(n*0+n*1+n*2+n*3+n*4+n*5)*100 / N*5$$

Per definition a DI of > 25 % detects varieties as susceptible.

RESULTS

Experiment 1: Monitoring of clubroot spreading

In this study occurrence of clubroot infection in commercial fields was mapped for Germany, Poland and Czech Republic (Fig. 2). The map shows high clubroot infestation for North-East Germany, North and South-West Poland and North and Central of Czech Republic. For France clubroot monitoring is shown from the studies conducted by CETIOM.

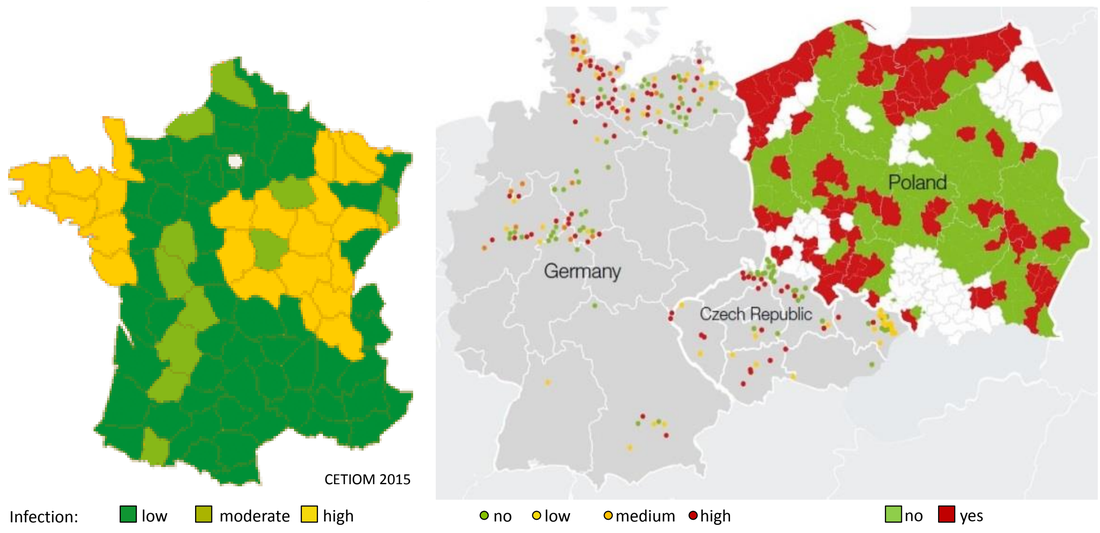

Fig. 2: Map of clubroot infected regions in Central Europe

Experiment 2: Pathotype identification

Example for presence of pathotype P3 according to Somé *et al.* 1996 (Tab. 1): *Cvs. Nevin* and *Wilhelmsburger* show no clubbed roots but roots of *cv. Brutor* are highly damaged by *P. brassicae*.

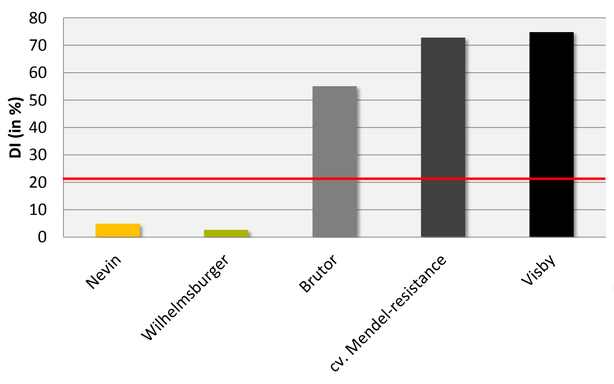

Fig. 3: Results of pathotype identification (Disease Index)

Fig. 4: Pattern of damage on examined varieties

Example for presence of pathotype P3 that breaks Mendel-resistance: Also both control varieties show damage on their roots. DI of these varieties are often higher than DI of *cv. Brutor.*

DISCUSSION & CONCLUSION

Monitoring of clubroot disease spreading was carried out in Germany, Poland and Czech Republic. These results add to existing monitorings (Diederichsen 2013, Dixon 2009, Zamani-Noor 2015). Knowledge on geographic dispersion of clubroot is important due to ongoing expansion of the disease. Further studies will be necessary in the future.

Results of pathotype identification show, that plants were infected by *P. brassicae* pathotype P3. Infection of variety with *Mendel*-resistance implies, that the pathogen was able to break resistance. Today, we also find pathotypes which are declared as P1 or P3 but, however, can break *Mendel*-resistance as well (Zamani-Noor 2015). These pathotypes are not observed by the differential set of Somé *et al.* 1996. Integrating *Mendel* to this differential set would make future identification of pathotypes more precise.

Today, it is the challenge for European breeders to detect new sources of resistance against clubroot and to introduce them in new competitive rapeseed varieties. For better disease control, monitoring of clubroot and identification of *P. brassicae* pathotypes is of high importance.

REFERENCES

CETIOM (2015): http://www.terresinovia.fr/colza/cultiver-du-colza/maladies/hernie/

Diederichsen (2013): *Clubroot in Germany and Europe.* International Clubroot Workshop. Edmonton, Canada. June 2013.

Dixon (2009): *The Occurrence and Economic Impact of Plasmodiophora brassicae and Clubroot Disease.* J Plant Growth Regul 28, p. 194-202.

Somé *et al.* (1996): *Variation for virulence on Brassica napus amongst Plasmodiophora brassicae collections from France and derived single-spore isolates.* Plant Pathol45 (3), p. 432-439.

Zamani-Noor (2015): *Verbesserung der Resistenz von Winterraps gegen Plasmodiophora brassicae unter Feldbedingungen.* DPG Arbeitskreis Raps. Braunschweig, Germany. February 2015.

CONTACT

Benedikt Flecke // benedikt.flecke@syngenta.com // Zum Knipkenbach 20, 32107 Bad Salzuflen, Germany

GCIRC

syngenta