Disease control in oilseed rape – future challenges through high intensity production and climate change

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Increased market demands for plant oils will result in the further rise of yield levels and a yet enhanced intensification of oilseed rape (OSR) production. This will aggravate the phytosanitary status of this crop unless significant progress is made in the integrated management of diseases. In addition, expected changes in climate may alter the prevalence of pathogens and their impact on yield (Siebold & Tiedemann 2011). Besides adapting agronomic measures the improvement of cultivars will play a crucial role to cope with enhanced disease pressure under altered environmental conditions. Among the currently prevailing diseases in worldwide OSR cultivation, Sclerotinia stem rot, Phoma blackleg and stem canker (except China), *Verticillium longisporum* (in Europe) and clubroot (*Plasmodiophora brassicae*) are soil- and/or straw-borne and thus primarily determined by crop rotation. Consequently, the levels of these diseases have significantly increased in the intense oilseed rape production areas in Germany and elsewhere in the past decade. Fungicides are mainly used for control of Phoma and Sclerotinia. Their efficiency can be improved by decision support systems (DSS; Koch et al. 2007; Steed et al. 2007), which however, have gained only limited acceptance in practice. This is partly due to the limited confidence of farmers into using DSS. Recently, the rise in commodity prices has significantly improved the economic efficiency of fungicide applications. However, in spite of regular fungicide use, the enhancement of disease pressure in intense crop rotations with OSR by increased inoculum levels in the fields has not been prevented.

Efforts in research and breeding to improve cultivar resistance have been focused on the four major diseases of OSR in moderate climatic zones, phoma blackleg/stem canker, sclerotinia stem rot, clubroot and Verticillium. Cultivars with improved resistance exist for control of Phoma and clubroot. Resistance to cubroot, however, is based on a single major gene and considered to be limited in efficacy and/or durability (Diederichsen et al 2006). Blackleg resistance has been much improved by introgression of major resistance genes (Kutcher et al 2010), however, this progress was hampered by the rapid occurrence of virulent pathotypes of *Leptosphaeria maculans* (Sprague 2010), which has strengthened the need of searching for additional polygenic resistance sources (Rimmer 2006). Presently, phoma control is based on growing resistant cultivars combined with fungicide (and insecticide) sprays.

There is some promising polygenic resistance to Sclerotinia stem rot in Chinese OSR lines, which however has not yet proven to be efficient in the disease hot spots outside of China (Zhao et al 2004). Besides, transgenic approaches have yielded promising results through overexpression of defense-related *MPK* genes (Wang et al 2009), or transformation with genes related to oxalate degradation (Dong et al 2008). There is some evidence from recent studies (unpublished), that some quantitative resistance sources exist in the wider *Brassica* gene pool, which might be exploited in future breeding programs. At present, control of sclerotinia stem rot exclusively relies on fungicide sprays in the disease hot spots outside China since none of the mentioned approaches to improve OSR resistance to sclerotinia stem rot has been transferred into cultivars for practical use.

Recently, some promising sources of resistance have been identified to improve breeding progress for control of *V. longisporum*. Sources for quantitative resistance mainly derive from *B. oleracea* (cabbage) and have been successfully introgressed into high-yield OSR resynthetic lines in Germany (Rygulla et al 2007). However, this horizontal resistance is acting internally in the hypocotyls, which does not impede the root penetration by the pathogen (Eynck et al 2009). The agronomic impact which this type of resistance might have on yield performance at high soil inoculum levels and under additional environmental stress such as drought is not yet known.

The damage potential of *Alternaria brassicae* is currently of minor importance in most OSR production areas. *Pyrenopeziza brassicae* (light leaf spot) plays a larger role only in Northern France und in the UK and can be effectively controlled with fungicides. Accordingly, breeding efforts addressing these diseases have been much less intense than those related to the major diseases above.

With expected climate change, which in higher latitudes may mainly consist of elevated temperatures during nights and in winter months, epidemic conditions are expected to shift the prevalence and priority of pathogens in the cooler climate zones of OSR production. In a recent study based on A1B regional climate scenarios for Northern Germany it has been hypothesized that Sclerotinia stem rot, *V. longisporum* and *Alternaria brassica*, may be favoured, while phoma blackleg may not benefit to the same extend and light leaf spot might even lose importance (Siebold & Tiedemann 2011). The precision of such predictions, however, is limited since a variety of crucial future climatic factors are difficult or impossible to estimate. The main uncertainties of climate prediction refer to precipitation patterns which however play a crucial role for moisture conditions during the season. In addition, current predictions hardly consider expected changes in plant physiology and development and adaptations of cropping systems and agronomic techniques, including novel cultivars, to a changed climate (Juroszek & Tiedemann 2011).

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