ABIOTIC STRESS

More dangerous than fungi and beetles in oilseed rape

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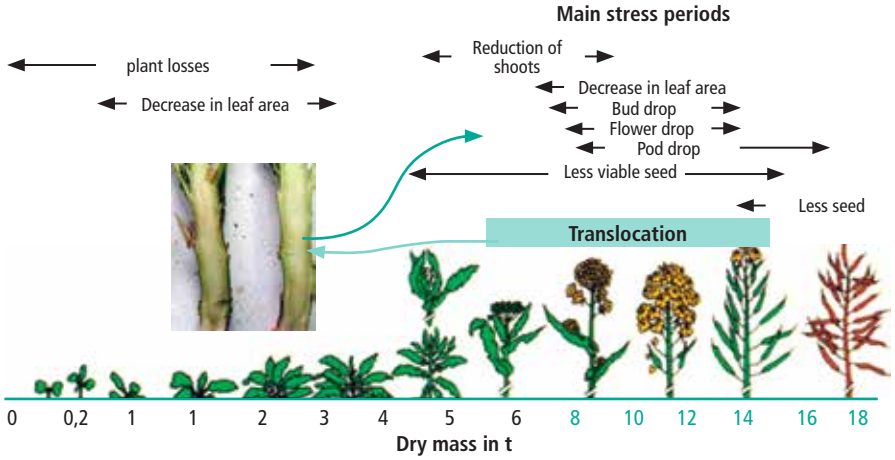
Abiotic stress is caused by environmental factors such as frost, drought, heat, excess rainfall etc. which impede normal plant growth. The use of fertilisers and pesticides provides limited opportunities to relieve stress in oilseed rape. As the most important tolerance factors are embedded in the varieties themselves, this is where modern plant breeding has focused its search for solutions.

In future it will not be possible to mitigate the effects of climate change through agrochemicals alone. It is also highly unlikely that the European Union will permit the use of more fertilisers, more pesticides or more intensive tillage and even tighter crop rotations in years to come. Therefore, the only relevant yield factor will be selective breeding to improve the crop's adaptability, i.e. the ability to respond to environmental changes. Modern oilseed rape varieties, for example, reveal which areas breeders have targeted to bring about further varietal improvements.

Fig. 1 : Stress periods during plant development



Source: Diepenbrock 2006, amended

Winter hardiness

Winter-kill has various causes; frost, snow cover, fungal attack, freezing, drying out. This is why breeders select not only for strong early growth, but also for a well-developed root system to firmly anchor plants in the soil and improve regeneration after winter. Progress has been made in recent years to improve frost hardiness. Leaf loss as a consequence of winter-kill can delay spring growth and reduce nitrogen efficiency, but does not pose a direct threat to the plant. Varieties such as AVATAR and MERCEDES have very frost-hardy leaves and buds. Bolting resistance is essential for winter hardiness since it ensures that delicate flowering parts remain well protected inside the plant. Varieties such as RAFFINESS and POPULAR are particularly good in this respect. They come into their own in eastern Europe, where growing conditions are far colder. As well as genetically fixed winter hardiness, the frost hardiness and sprouting behaviour/stem development of plants can be improved through the use of triazoles. It is not compression of the shoot that matters here, but rather dehydration of the whole plant.

IMPROVED ROOT GROWTH HAS LED TO A HIGHER NITROGEN EFFICIENCY OF THE VARIETIES. EVEN DEEP NITROGEN DEPOSITS CAN BE REACHED.

Heat

Oilseed rape is at its most sensitive during flowering (Fig. 1). The yellow flower canopy prevents assimilation, thus making the plant entirely reliant on its existing carbon and nitrogen reserves. Whilst nitrogen is stored mainly in the leaf and stem area, carbohydrates have to be transported from the root cortex to the flowers. This process is dependent on water transportation, which is disrupted by very high temperatures. Disruption during transfer from the lower to the upper levels of the plant leads to a physiological disorder known as bud wilt. If the surface of the leaves is exposed to temperatures above 30 °C, the plant protects itself against the effects of sun and heat by added wax formation. Wax is a fat, just like vegetable oil. Carbon (C) plays a vital role in the synthesis of both oils and proteins. Once it has been incorporated into the layers of wax, it is no longer available in sufficient quantities for other yield components. To prevent oxidative heat stress during the flowering period, breeders have spent the past 35 years working to shift the timing of flowering forward 10 days to take advantage of the cooler weather. Despite rising temperatures year on year, the weather is now cooler than before at the time of flowering. So earlier flowering is combined with slightly later ripening, thus extending the pod assimilation period and hence leading to the very high yields we see today.

Drought

Water stress rises dramatically when the water-holding capacity of the field falls < 30 %. However, winter oilseed rape is still better equipped to deal with current drought scenarios than any other crop. For one thing, it can store considerable quantities of water and for another, the root system often extends several metres into the ground, accessing deeper water-bearing layers.

Root research has made considerable progress in recent years as modern sensor systems and better measurement techniques facilitate further adaptations to the changing climate. Since deep root activity mostly takes place in autumn in long-day conditions, a rapid and early growth is particularly important. The underlying principle here is leaf first, then root. Varieties such as BENDER and PENN epitomise this desirable type. Sowing earlier in the season improves water efficiency, provided that overgrowth is avoided. Thus in dry areas it is advisable to sow early to obtain longer roots. Suitable varieties such as RAFFINESS are bolt-resistant, phoma-resistant and winter hardy. These three traits are essential in spring sown varieties.

Wet

Climate change scientists predict that weather patterns will shift. Even in the past 15 years, winters have become significantly milder, springs and summers dryer and there is often more rainfall at harvest time. Nevertheless, dry spells at the time of sowing still pose the greatest risk. Sowing increasingly takes place in wet conditions, which is good for field emergence. For root development, however, it is less than ideal because roots tend to follow the water as it seeps into the ground. If water accumulates in the topsoil, the taproot is unable to perform its main function. Oilseed rape is not designed to cope with standing water. The only way to deal with this is through soil-friendly tillage that encourages capillary movement and careful timing of tillage and sowing.

Leaf loss as a consequence of winter-kill can delay early growth and reduce nitrogen efficiency.

Conclusion

Everyone is talking about abiotic stress in the light of our changing weather patterns. Varieties improved by selective breeding can remedy the situation. The RAPOOL oilseed rape breeding alliance offers a range of varieties with improved adaptation to changing winter weather, longer dry spells and higher temperatures. The key to successful oilseed rape production is a combination of farming skills and modern agricultural equipment as well as adaptive, very high yielding varieties with established agronomic traits.

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