Black rot in vegetable brassicas

Action points

For growers

- Confirm that brassica seed has been tested for Xanthomonas to an appropriate standard
- Request information from seed suppliers on the effective tolerance standards applied (e.g. number of seeds tested)
- Check that transplant suppliers only use tested seed and have appropriate hygiene policies
- Don't dip transplants before planting
- Clean and disinfect machinery and equipment, clothing and footwear when moving between crops
- Post-harvest cultivations should aim to encourage rapid breakdown of crop residues
- Use a non-brassica break crop in the rotation for two years after field outbreaks of black rot

For plant propagators

- Confirm that all brassica seed coming on to the unit has been tested for Xanthomonas to an appropriate standard
- Request information from seed suppliers on the effective tolerance standards applied (e.g. number of seeds tested)
- Module trays should be cleaned and disinfected before each use
- Clean and disinfect sowing equipment before each new batch of seed
- Clean and disinfect glasshouses/bays before each batch of transplants
- Separate batches of plants grown from different seed lots as much as possible
- Minimise the use of overhead irrigation
- Consider the use of drip/trickle systems
- Clean and disinfect equipment between batches
- Don't water transplants using flood irrigation

Black rot (*Xanthomonas campestris* pv. *campestris*) is considered one of the most important diseases of brassicas worldwide. At its most severe it can cause complete crop loss, but this is less likely under UK conditions than in warmer climates. However, it regularly caused significant losses in marketable yield in the UK in the late 1990s, particularly in autumn and winter crops. It is now less common, most likely due to improved understanding of the epidemiology and the application of more stringent seed health standards appropriate to the production systems.

Symptoms

The most obvious and characteristic symptoms in the field are yellow 'V-shaped' lesions with blackened veins that develop from the edges of the leaves (Figures 1 and 2). As the lesions enlarge they become necrotic, pale brown and dry, due to blocking of the vascular system. Systemic infection can also be seen as blackened vascular bundles (Figure 3) in the leaf petiole or main stem and result in (often one-sided) wilting. Severe infections can result in stunted or dead plants.

Leaf loss can also occur at relatively low levels of infection and this can be a particular problem in winter cauliflowers, when wrapper leaves are lost, exposing the curd, so that it becomes unmarketable. Secondary soft rots may also occur, exacerbating the symptoms in cabbage and cauliflower.

Figure 1. Typical field symptoms of black rot in a winter cabbage crop: yellow V-shaped lesions developing from the leaf edges

Figure 2. Close-up of a V-shaped lesion

Figure 3. Blackened major veins on a cabbage leaf

Less commonly, the disease may be seen as dark, water-soaked spots or larger areas on leaves, which may progress to become systemic, with the typical symptoms described above or papery 'blight' symptoms (Figure 4). However, water-soaked leaf spots can also be caused by other bacterial pathogens such as *X. campestris* pv. *raphani* or *Pseudomonas syringae* pv. *maculicola.*

Initial symptoms can be difficult to spot in seedlings and transplants. Infected cotyledons may have slight yellowing and necrosis (Figure 5) but often shrivel up completely and drop off before they are noticed. Typical lesions may develop on young leaves, but transplants are often planted out before they are obvious or have had time to develop.

Figure 4. Papery blight symptoms on cauliflower

Figure 5. First symptoms on cotyledons in transplants are difficult to spot

The pathogen and biology

The disease is caused by the rod-shaped, motile, gram-negative bacterium *Xanthomonas campestris* pv. *campestris*. All cultivated brassicas, radish, cruciferous weeds and a number of ornamental species can be infected. However, the pathovar is divided into a number of distinct races, which have different host ranges. There are currently at least nine races; these are differentiated by their pathogenicity on a number of differential brassica species and cultivars. Worldwide, races 1 and 4 are the predominant races in vegetable brassicas. The apparent dominance of these races may reflect the lack of resistance to these races in the hosts.

Most infection occurs via hydathodes (pores at the edges of leaves) and is the reason for the most typical symptoms, but infection can also occur via stomata or wounds caused by hail or mechanical damage.

The disease is generally considered to be favoured by warm wet weather; at optimum temperatures (*c.* 25°C), symptoms generally take 10 to 14 days to appear following infection, but may take much longer at lower temperatures.

Epidemiology

Seeds are the primary source of inoculum and means of long-distance spread. Although crop debris and cruciferous weeds can potentially act as sources of inoculum, almost all significant field outbreaks of disease have been associated with seed infection. In the past, certain varieties have been noted as being more susceptible than others, when, in fact, differences may have been due to the presence/absence of infection in the seed stocks.

Most local (within-crop) spread occurs by water splash, irrigation or wind-driven rain, but anything that moves within and between crops, such as people, animals, insects, equipment and machinery, can potentially spread the bacterium. It is important to be aware that considerable numbers of bacteria may be present and significant spread may have already occurred before any symptoms are seen.

Of critical importance is the potential for very rapid spread in transplants with the overhead gantry irrigation systems typically used by plant propagators. Thus, even relatively low levels of seed infection can result in almost all transplants being contaminated at the time of planting. Experimental data has demonstrated spread from one infested seed to 4,500 transplants in six weeks. Most of these transplants are likely to be symptomless and symptoms then ‘suddenly’ appear simultaneously in the field throughout the whole crop when suitable conditions occur.

In the UK, the disease has been more commonly associated with late-autumn and winter crops. Module transplants for these crops are raised during the hottest months of the year, resulting in much more frequent irrigation and potential for spread than in transplants raised for early crops.

Carry-over in the field has been shown to occur when crop debris from the previous crop was still visible in the soil, but as the rate of spread is much lower than in transplants, the pattern of disease is likely to be much more patchy and overall disease levels lower than when infection has originated from seed and transplants.

The pathogen may survive for long periods in dry crop debris or in infested seeds. It does not appear to survive or compete well when free in the soil and so is likely to survive only as long as the crop debris.

Control

Seed testing and treatment

The primary means of control is to use healthy seed, which has been tested to confirm that it meets the required standards.

Modelling of different risk scenarios has indicated that effective control (overall risk of disease less than 10%) in transplanted brassicas can be achieved by testing 6 x 10,000 seeds by a method that incorporates a centrifugation step.

Hot water and similar physical treatments may be considered if valuable seed stocks are known to be infected, but it is vital that post-treatment testing is performed to demonstrate that the treatment has been effective.

Chemical

Attempts at chemical control in the field are unlikely to be cost-effective, as significant spread has most likely occurred by the time symptoms are seen.

There are currently no chemical controls approved for use.

Biological

The biopesticide Serenade (*Bacillus subtilis* QST 713) has some activity against Xanthomonas. As a weekly spray, it gave some (but not significant) reduction in spread in transplants. It has current authorisations, EAMU 20130706 and EAMU 20182357 (Nov 2018).

Hygiene

Good hygiene is essential, to prevent cross-contamination between different batches of transplants on the nursery and to prevent spread from affected to nearby healthy crops in the field:

- Module trays should be cleaned and disinfected before use
- Glasshouse bays should be cleaned and disinfected between batches of transplants
- Machinery, clothing and footwear should be washed down and disinfected after visiting infected crops
- Most general-purpose disinfectants are likely to be effective against Xanthomonas

Crop Rotation

Infected crop debris should be chopped as much as possible to encourage rapid breakdown and there should be a two-to three-year break from brassicas to ensure residues have completely disappeared.

Plant resistance

Breeding resistant varieties has long been recognised as an important target for disease control and was the focus for a lot of work in the late 1990s and early 2000s. It should also be noted that some varieties are already resistant to some races of the pathogen. Useful sources of resistance have been identified and their inheritance studied, particularly in non-vegetable brassica (i.e. not *B. oleracea*) species, but seems not to have been a priority for commercial breeders in recent years.

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Further reading

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