Crop specific guidance

Brassicas - Cabbage, Cauliflower, Brussels sprouts and Broccoli

The IPM Tool allows you to prioritise pests that are important on your farm. This helps guide decisions on which IPM measures are appropriate. Implementing IPM can result in 'trade-offs' where methods to control one pest may increase another. Some of these trade-offs are included in the notes below and in the Tool. Prioritising pests will help decide which pests are most important where there are trade-offs. This guidance documents provides advice on IPM measures for brassicas insect pests and diseases. For information on IPM interventions for weeds, refer to the separate IPM Weeds guidance document.

Insect Pests

Insect pests in brassicas cause damage to the crop either through direct feeding or through the transmission of viruses during feeding, although in some instances the presence of some damage will not necessarily impact on marketable yield. Few non-chemical control methods are likely to be 100% effective, but they do reduce the requirement for chemical control. Combinations of one or more IPM techniques are likely to be most effective.

The main principle, with the exception of cabbage root fly, is that control measures should only be applied when the pest is present. Routine applications of insecticides at set time intervals are not best practice and should be avoided as the only means of control. Prevention in the first instance is more effective than curative spray applications, therefore where possible, an integrated approach is recommended.

The cabbage root fly, aphids, caterpillars, and whiteflies are the most common insect pests. For effective control of cabbage root fly preventative treatment is necessary. Aphids, caterpillars, and whiteflies can be adequately controlled in response to thorough crop monitoring, taking note of any threshold levels and ensuring to use insecticides that are selective to preserve populations of beneficial predators and organisms. Product choice should also consider efficacy and longevity of treatment against the target pest.

Insecticide resistance is becoming increasing common within insect populations. It is important to alternate the use of different active ingredients where available to enable the best chance of control with the existing range of active ingredients. Use the minimum effective dose rate, normally being that recommended, and do not reduce dose rates for insect pest control. Consider the use of natural and biological methods of pest control if available.

Selecting low-risk locations

Where geographical and agricultural factors permit choose sites away from existing brassica and oilseed rape production to avoid a continuous 'green bridge' throughout the year. Avoid proximity to the previous crops residues if they are still present on the soil surface and not incorporated. Vegetable brassicas and oilseed rape crops represent a significant winter host for whitefly, and where practical avoid planting/sowing spring crops near winter whitefly hosts.

Control volunteers & weeds

Cabbage aphids will overwinter on brassica crops and weeds through eggs laid in the autumn. A key cultural practice for the management of cabbage aphid is to destroy and/or bury brassica crops and weed residues to bury the eggs. Similarly, the management of brassica weeds e.g. mustards, is of significance especially with the recent rise in popularity of brassica based cover crop mixes.

Seed bed management

Pests can be killed or brought to the surface where they are eaten by birds or die due to dehydration. Most cabbage aphid infestations develop from colonies that overwinter on old brassica crops and autumn sown oilseed rape. Undisturbed trash or crop residue can provide shelter and food for pests such as slugs. Plough in or otherwise destroy such crop residues, however, additional cultivations can increase carbon footprint and reduce soil biodiversity.

Cloddy seed beds can potentially allow slugs access to developing brassicas. Instead, consolidate soils to inhibit slug movement where necessary. Rolling soil post-planting can improve the seedbed quality, resulting in more rapid germination of crops and reducing access of soil-borne pests, such as slugs, to seeds. Rolling may also kill some pests or reduce their mobility.

In field non-cropped areas / Beetle banks / Diverse crop margins or strips

Beetle banks consist of stands of wildflowers and grasses and are designed to act as reservoirs of beneficial insects such as ground beetles and parasitoids, which help to provide natural biological control of insect pests.

Diverse crop margins and strips act in a similar way to beetle banks to increase natural enemies. However, some of the plant species could benefit pests. More diverse strips should harbour greater biodiversity and greater numbers of beneficials. Ladybirds, hoverflies and lacewings are natural enemies of aphids in brassicas. The cabbage root fly is attacked by two main parasitoids, wasp and rove beetle. Cabbage aphids have only one parasitoid, the small wasp *Diaeretiella rapae,* which also attacks the peach potato aphid. Caterpillar pests are also attacked by a range of parasitoids, mainly wasps and flies. Rates of parasitism vary from crop to crop and are reduced usually where broad spectrum insecticides are used.

Bioprotectants microbial

Insect pests may be attacked by a number of bacterial, fungal and viral diseases. Fungal diseases can be particularly devastating, but may be triggered only when environmental conditions are favourable. In brassicas, the bacterium *Bacillus thuringiensis* subspecies *kurstaki* ABTS-351 (DiPel DF, EAMU 3028/19) is approved for use against young caterpillars of most species infesting brassica crops, although rates of control of cabbage moth can vary. Caterpillars ingest the bacteria which releases a fatal toxin as it breaks down and the caterpillar activity and feeding stops immediately, followed by death after four to five days. This biopesticide is most effective when applied to actively feeding, young larvae.

Bioprotectants natural substances

Monitoring slug numbers with surface bait using bran to determine need and timing of further control measures. The use of nematode slug treatments such as Nemaslug®, has been shown to provide protection against many species of slugs including grey field slug (*Deroceras reticulatum*). The main advantage of this biocontrol is being the lack of toxicity to earthworms, who are useful incorporators and decomposers of potentially infected crop residues. As this product is a biological it requires both the right temperature (above 5°C) and high humidity to work optimally, which mirrors the conditions under which slugs are most active, however irrigation may be needed to keep the nematodes alive during dry spells. To achieve optimal protection multiple applications are usually required. The action of biological molluscicides under plastic film can also be irregular. If sufficient moisture is present when the plastic film is laid, initial results may be favourable due to the humid condition, however depending on the longevity of the film irrigation options such as drip line systems may be required.

Majestik is a contact insecticide containing the natural substance maltodextrin approved for use on all edible crops and has been known to give control of whitefly and some reduction of aphid numbers. Majestik can have adverse effects on non-target insects or other beneficials that are covered by the spray but has no residual effect.

Precision Irrigation

At transplanting avoid over watering as this can leach out cabbage root fly insecticides. It is advantageous to have modules analysed routinely to check whether the propagator has applied the correct rate of cabbage root fly insecticide. This is especially important prior to the peaks of first and second-generation cabbage root fly.

The best response to irrigation in the field is likely to be obtained following rapid establishment by irrigating immediately after planting out transplanted crops. Plants under drought stress tend to be susceptible to attack by pests; therefore, irrigation helps to improve yield and quality. Where available, apply 25mm of irrigation at 25mm soil moisture deficit. If water supply has been limited, an application of 25mm, made 21 days before cutting, has proved to be beneficial.

The use of well-timed irrigation, especially overhead, has been shown to reduce incidence of caterpillars, as it can kill larvae. For example, cutworm attacks are most severe in hot dry summers, and irrigation can wash young cutworm off plants before they descend to the soil to feed. Warnings are issued based on trap catches sometimes combined with a weather model to define 'high risk' periods, when the caterpillars are small and can be controlled by rainfall or irrigation. Use pheromone traps to monitor moth numbers. If local information is not available and irrigation is possible, apply at least 20mm of water as advised by the cutworm warning. In absence of rainfall or irrigation, a well-timed insecticide spray maybe required as recommended by the spray warning.

Physical exclusion of pests

Fine mesh netting (crop covers) may prevent pests from laying eggs on or burrowing into susceptible crops. They can lay eggs on or through netting that touches the crop and if needed hoops can be installed beneath the net to prevent the crop touching the netting.

Decision support, including monitoring

Crops should be regularly and systematically inspected to monitor crop development, and pest and disease levels. Increase the frequency of crop walking during periods of high pest incidence particularly during hot weather. In addition to crop walking, consider the use of insect traps e.g. pheromone traps, chemical attractant traps and soil sampling (cabbage root fly eggs) as monitoring tools.

IPM decisions should be made based on the results of monitoring and forecasting combined with threshold information where available. Treatment thresholds are the population level or density that must be reached before intervention becomes economically beneficial. Thresholds enable growers to make decisions based on the level at which pests will impact economic crop yield. They are essential in guiding pest control decisions and preventing the unnecessary use of pesticides.

Planning the optimum non-chemical strategy for managing each pest can help to avoid 'fire engine' use of pesticides. Previous records of pest damage are very useful to help predict the likely timing of pest attack. Records should also be kept of the success of non-chemical pest control strategies.

Aphid populations can be reduced by a multitude of insect predators and crops should be walked regularly to determine the balance of predators in relation to plant size, to determine whether the crop needs a spray application, or whether the predators will naturally control the aphids. Many factors are involved in this biological 'integrated' approach and the risk associated with the various crop-walking techniques should be considered along with crop stage.

- Rothamsted Insect Survey release regular results from their network of suction traps, identifying all **aphids** caught: https://insectsurvey.com/archive0
- The WCC also monitors **cabbage aphids**: https://warwick.ac.uk/fac/sci/lifesci/wcc/research/croppests/updates/2023/aphids/brevicoryne/

For caterpillar populations, frequent crop walking is essential to identify both the caterpillar species and natural predator presence. Caterpillar predators are unlikely to give effective control where levels are high but may adequately control low infestations. Some caterpillar species only have one generation per year and thus if there is a low-level infestation on the vegetative parts of the plant, chemical control may not be necessary.

- WCC monitors **diamond-back moths**: https://warwick.ac.uk/fac/sci/lifesci/wcc/research/croppests/updates/2023/dbmpheromone/
- **Silver Y moths** are captured by a network of pheromone traps run by the Allium and Brassica Centre/Syngenta UK for Lincolnshire https://warwick.ac.uk/fac/sci/lifesci/wcc/research/croppests/updates/2023/sysightings, as well as by WCC in Wellesbourne: https://warwick.ac.uk/fac/sci/lifesci/wcc/research/croppests/updates/2023/mothtrap/
- WCC also traps **turnip moths** https://warwick.ac.uk/fac/sci/lifesci/wcc/research/croppests/updates/2023/mothtrap/

For cabbage root fly monitoring methods include counting eggs laid at the base stem to predict the size of the next generation of larvae and non-selective water traps that catch adult flies. The Warwick Crop Centre computer prediction model gives the timing and duration of populations based on statistical information and local weather data. It can be used to predict high pressure periods and therefore when crop damage is most likely.
A chemical attractant trap is available that selectively traps adult flies and thus, in future, a combination of this trap and the Warwick Crop Centre (WCC) computer prediction model may give a more reliable monitoring system.

- **Cabbage root fly** forecasts are available https://warwick.ac.uk/fac/sci/lifesci/wcc/research/croppests/updates/2023/crf/ as well as monitoring data for Wellesbourne: https://warwick.ac.uk/fac/sci/lifesci/wcc/research/croppests/updates/2023/watertrap/

Diseases

Broccoli, Brussels sprouts, cabbage and cauliflower are prone to infection by the same pathogens as fodder and oilseed brassicas including dark leaf spot (*Alternaria brassicae* and *Alternaria brassicicola*), downy mildew (*Hyaloperonospora brassicae*), light leaf spot (*Pyrenopeziza brassicae)*, ringspot (*Mycosphaerella brassicicola*), phoma (*Leptosphaeria maculans* and *Leptosphaeria biglobosa*) and bacterial black rot (*Xanthomonas campestris* pv. *campestris)*. Regular monitoring during propagation and in the field, coupled with correct identifications of diseases and the use of a disease forecasting system, where applicable, are important in ensuring fungicides are applied for optimum efficacy.

Most of the pathogens cause spots or blemishes on the leaves / head rendering them unmarketable or requiring trimming. These diseases are prevalent in the main production areas in most seasons. This is partially due to the growing of oilseed rape and the proliferation of rape volunteers, but poor separation between vegetable brassica crops can also facilitate disease survival and spread.

Where possible, the guiding principle is that pesticide inputs should be minimised through prevention rather than applied curatively in response to disease. Where possible an integrated approach is needed where diseases are managed by combining biological, cultural, physical and chemical options.
Brassica Diseases Guide | AHDB

Field history, rotation & break crops

Maintain records of disease problems whether across whole fields or as patches, to enable either avoidance of planting while the pathogen is likely to persist in the soil or volunteers, or increased monitoring to allow rapid management of any disease appearance if a susceptible crop is planted. If a field has a history of a certain disease, it is likely that this will return as a problem in the future, either through survival in the soil or on debris, or on a green bridge host plant for diseases or virus vectors. Alternaria, light leaf spot, ringspot and Xanthomonas will spread between cruciferous host debris. It is good agronomic practice to rotate crops with non-host species to prevent the build-up of soil-borne diseases, and it also allows an opportunity to control volunteers which can act as a reservoir of disease. A four-year rotation is recommended, but in intensive production areas where this is not possible good agronomy and disease monitoring to a high standard is required. Club root is a problem in some brassica production areas particularly on naturally acid soils. Production in these areas should be based on a wider rotation of four to five years between brassica crops together with a well-planned liming policy.

Select low-risk locations / Spatial separation

Wetter areas in the West of England can be more at risk of ringspot. Proximity to other brassicas should be avoided to reduce the chance of cross-infection. If possible, site away from crops such as oilseed rape and other brassicas. In intensive brassica areas, where this is not possible, plough in plant remains immediately after harvesting ceases, to prevent the spread of trash-borne diseases such as dark leaf spot, light leaf spot and ringspot. Brassicas thrive best on moisture retentive high alkaline situations and often continuous production can be sustained without detriment to crop quality or to the environment, but only with consideration to the avoidance of disease carry over by incorporating post-harvest residues and by maintaining a satisfactory record of pH levels with a good liming policy.

Early production under crop covers

Physiological problems soon arise if cover sheets are left on too long and can encourage moisture and humidity for downy mildew infection. Uncover when the heads are just visible (10-15mm in diameter). Crops should also be uncovered if the weather conditions are hot and humid. It is worth sacrificing crop advancement in exchange for a reduced disease problem.

Soil management and good drainage

Free-draining yet moisture retentive soils should be developed, either through suitable cultivation techniques, use of penetrative root growth cover crops, increasing organic matter following incorporation or direct organic matter application. Examine soil physical structure as well as sampling for nutrient status testing, ideally utilising the AHDB soil health scorecard, sampling protocol and benchmarks.

Wet areas and fields subject to flooding are likely to be more prone to diseases not only because of poor plant growth but also because some pathogens are adapted to conditions of high soil moisture. Deficiencies of soil nutrients and adverse soil seed bed conditions because of poor drainage are also likely to predispose plants to disease. Improve soil drainage and structure to allow good root system development and thus stronger growing, less stressed, plants that with greater disease tolerance.

Precision Irrigation

Field irrigation that leaves puddles facilitates pathogen spore splash from the soil onto foliage and thus closer monitoring of set timings are required. Devices that monitor the amount of rain and irrigation water falling onto plants and/or soil or growing-media moisture content should be utilised ideally alongside visual inspection to adjust irrigation timings. The ideal would be to avoid overhead irrigation, especially over module trays, and use sand-beds, drip-hose or similar systems that water the roots and so do not wet the leaves and provide good conditions for spores to germinate.

Control volunteers & weeds

Cruciferous volunteers and weeds act as a ‘green bridge’ allowing continued pathogen survival and from which spores and insect-borne viruses can be spread to infect new brassica crops. Most brassica pathogens can also be transmitted from plant host debris, although mildews require living hosts for survival. Ideally, infection sources in nearby fields should be destroyed prior to the emergence of new crops as well as in the field to be planted. A fallow period will allow time for pathogen viability to be reduced. Disease hosts can be killed by herbicides, but pathogens can remain active on dead material at least until the plant tissue disintegrates and so chopping up plant tissue will hasten disintegration.

Primary Cultivations / Crop residue burial

Carry out primary cultivations such as ploughing to bury plant matter out of contact with the next crop. If this is not done and no interval left between cruciferous crops, break crops or weeds, then disease transfer is a possibility. Burial of debris will reduce the spread of light leaf spot, ringspot and other diseases by stopping splash-dispersed spores from living tissue, and halt formation of the ascospore stage which is released from debris and dispersed widely in the air. Where xanthomonas is found, quick removal or soil incorporation of crop residue is advised and a rotational break of at least two years should be practised. However, a four-year interval is in general advised between brassica crops.

Hygiene

Adequately sterilise propagation trays and other glasshouse surfaces to prevent carry-over of root and leaf pathogens. Reduce movement of pathogens on workers coming from the field by disinfection of footwear and use of clean coveralls and hand sanitisation.

The introduction of soil-borne diseases and leaf pathogens carried on plant debris into clean land can be stopped by not moving soil or fresh plant waste between fields. Machinery used in infested fields should be power-washed after use in infected fields, and soil should be cleaned from boots and tools and ideally disinfected. Clean fields should be visited first in the sequence of crops so that cleaning down equipment can be done at the end of the day.

Variety choice / Resistant varieties

Resistant varieties are an important part of non-chemical disease control. Some brassica varieties have resistance to clubroot, ringspot, white blister (*Albugo* sp.) and fusarium and tolerance to systemic downy mildew. This is not across the full range of varieties, but specific resistances of individual varieties can be found in individual seed houses' brochures. Provided they have good commercial qualities, disease resistant varieties should be included in any integrated crop management system.

Cabbage: in general, savoy cabbages have the most complete resistance packages.

Broccoli: flat-headed varieties, with large beads and low wax levels, tend to succumb quicker to spear rot. Some varieties, under certain conditions, can be susceptible to hollow stem.

Cauliflower: some varieties under certain prescribed conditions can be susceptible to hollow butt.

Seed testing

Major seed lots are batch tested, in particular for alternaria, phoma and xanthomonas. A negative result does not guarantee complete freedom from the disease but more usually subsequent disease expression is not economically significant. Only certified seed should be used for the planting of new crops.

Decision support including monitoring and forecasting

Regular monitoring, both during propagation and in the field, coupled with correct identification of diseases, is an important element in minimising fungicide use. Regularly field walk and monitor the crop for diseases, in conjunction with monitoring pests, to establish the need to take corrective action. The decision on whether it is worthwhile to apply fungicides should consider the disease, time of year, degree of infection and proximity to harvest date. The effect of prevailing weather conditions on disease multiplication should also be considered.

Regular examination of propagation or field areas is required by staff able to recognise diseases and aware of any locations within the crop more likely to become affected. Correct identification of diseases is essential to determine the correct fungicide product to use. Early alerts to treat from disease epicentres can reduce the area that requires treatment as it will reduce spore spread to new growth and neighbouring plants.

Low levels of disease on the outer leaves of winter cabbage can be ignored as they can be trimmed, but where build-up becomes severe, eradicant fungicides should be applied before the marketable head is affected.

Chemical fungicides can be applied once a disease is present. Treatment can be triggered when infection is likely to occur based on disease alerts utilising local weather and in-crop monitoring. These should be from close proximity to location to be treated, however systems, such as "Brassica Alert" (www.syngenta.co.uk/brassica-alert) using reports from Lincolnshire for ringspot and white blister.

Spore sampling to confirm the presence of spores of pathogens such as ringspot, white blister, light leaf spot and powdery mildew can be done to confirm the pathogen is present in the vicinity of the crop and could be more widely adopted by growers for decision support in tandem with a forecast of favourable weather conditions for infection. However, the relationships between inoculum concentrations and potential resulting disease severities in each cropping situation will be unknown.

Where fungicidal control is required the following points should be considered, whilst ensuring effective control is achieved:

a. Use the least toxic and persistent product.
b. Use the minimum effective dose rate.
c. LERAP e.g. check that use within 5 metres of watercourse bank tops is approved.

Carefully consider anticipated harvest date and ensure the chemical selected has an appropriate harvest interval.

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