◆ EPPO Standards ◆

GUIDELINES ON GOOD PLANT PROTECTION PRACTICE

RAPE

PP 2/8(1) English

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APPROVAL

EPPO Standards are approved by EPPO Council. The date of approval appears in each individual standard.

REVIEW

EPPO Standards are subject to periodic review and amendment. The next review date for this set of EPPO Standards is decided by the EPPO Working Party on Plant Protection Products.

AMENDMENT RECORD

Amendments will be issued as necessary, numbered and dated. The dates of amendment appear in each individual standard (as appropriate).

DISTRIBUTION

EPPO Standards are distributed by the EPPO Secretariat to all EPPO Member Governments. Copies are available to any interested person under particular conditions upon request to the EPPO Secretariat.

SCOPE

EPPO guidelines on good plant protection practice (GPP) are intended to be used by National Plant Protection Organizations, in their capacity as authorities responsible for regulation of, and advisory services related to, the use of plant protection products.

REFERENCES

All EPPO guidelines on good plant protection practice refer to the following general guideline:

OEPP/EPPO (1994) EPPO Standard PP 2/1(1) Guideline on good plant protection practice: principles of good plant protection practice. *Bulletin OEPP/EPPO Bulletin* **24**, 233-240.

OUTLINE OF REQUIREMENTS

For each major crop of the EPPO region, EPPO guidelines on good plant protection practice (GPP) cover methods for controlling pests (including pathogens and weeds). The main pests of the crop in all parts of the EPPO region are considered. For each, details are given on biology and development, appropriate control strategies are described, and, if relevant, examples of active substances which can be used for chemical control are mentioned.

EUROPEAN AND MEDITERRANEAN PLANT PROTECTION ORGANIZATION
ORGANISATION EUROPEENNE ET MEDITERRANEENNE POUR LA PROTECTION DES PLANTES

PP 2/8(1) English

Guidelines on good plant protection practice

RAPE

Specific scope

This standard describes good plant protection practice for rape.

Specific approval and amendment

First approved in September 1996.
Edited as an EPPO Standard in 1998.

This guideline on GPP for rape forms part of an EPPO programme to prepare such guidelines for all major crops of the EPPO region. It should be read in conjunction with GPP Guideline no. 1 (Principles of Good Plant Protection Practice) (*Bulletin OEPP/EPPO Bulletin* **24**, 233-240, 1994). The guideline covers methods for controlling pests (including pathogens and weeds) of production crops of *Brassica napus* (oilseed rape).

Rape is mainly sown in the autumn (winter rape) and this guideline mainly concerns the winter crop. However, similar pests affect spring crops of rape, and the principles of this guideline can easily be adapted for this crop, at different times of the year. At some points specific indications are given for spring rape. This guideline could also readily be adapted for *Brassica campestris* subsp. *oleifera* (turnip rape). In general, GPP for rape starts with avoidance of pests. Adequate crop rotation should be practised. It is generally not advisable to plant both winter and spring rape in the same areas, as this increases the risk of build-up of pests in the spring crop. Also, rape is often grown as a break crop in intensive cereal-growing areas. It is then important not to include rape too often in the rotation, as pests may build up to a level where the crop can no longer be grown economically.

Rape is grown from seed and it is GPP to prefer seed treatments with plant protection products to field treatments, if possible. In the field, products are generally applied as sprays. Thresholds and crop management systems are available as aids to decide the timing of such sprays and even the choice of product, and it is GPP to use these. Application of sprays from flowering onwards can mechanically damage the crop, and this should be taken into account in making treatment decisions.

In general, the strategy for GPP in rape can be summarized as: crop rotation (with 4-6 years between crucifer crops), use of healthy seeds, good preparation of the seedbed for rapid crop establishment, use of cultivars with good resistance (especially to diseases), use of thresholds for treatment decision.

It should be noted that most rape pests are also pests of other brassicas, so there is a risk of movement between crops. Information in the EPPO Guideline for GPP in vegetable brassicas (*Bulletin OEPP/EPPO Bulletin* **26**, 311-347, 1996) may also have some relevance for rape.

The principal rape pests considered are the following:

- *Sclerotinia sclerotiorum* (stem blight);
- *Botrytis cinerea* (grey mould);
- *Alternaria brassicae* (black spot, dark leaf spot);
- *Leptosphaeria maculans* (phoma leaf spot, black leg, canker);
- *Peronospora parasitica* (downy mildew);
- *Erysiphe cruciferarum* (powdery mildew);
- *Pyrenopeziza brassicae* (light leaf spot);
- *Pseudocercosporella capsellae* (white leaf spot);
- damping-off diseases;
- *Plasmodiophora brassicae* (clubroot);
- virus diseases;
- *Psylliodes chrysocephala* (cabbage stem flea beetle);
- *Phyllotreta* spp. (flea beetles);
- *Ceutorhynchus pleurostigma* (turnip gall weevil);
- *Ceutorhynchus napi* (cabbage stem weevil);
- *Meligethes aeneus* (pollen beetle);
- *Ceutorhynchus assimilis* (cabbage seed weevil);
- *Dasineura brassicae* (brassica pod midge);
- *Brevicoryne brassicae* (mealy cabbage aphid);
- *Athalia rosae* (Japanese cabbage sawfly);
- slugs;
- nematodes;
- weeds.

In addition, information is given on GPP in the use of haulm killers (desiccants).

Explanatory note on active substances

The EPPO Panel on Good Plant Protection Practice, in preparing this guideline, considered information on specific active substances used in plant protection products and how these relate to the basic GPP strategy. These details on active substances are included if backed by information on registered products in several EPPO countries. They thus represent current GPP at least in those countries. It is possible that, for any of numerous reasons, these active substances are not registered for that use, or are restricted, in other EPPO countries. This does not invalidate the basic strategy. EPPO recommends that, to follow the principles of GPP, only products registered in a country for a given purpose should be used.

Sclerotinia sclerotiorum (stem blight)

General

Symptoms of this fungal infection appear on plants in late May and in June. A whitish to silvery discoloration appears around stem segments up to 30 cm in length. The surface of the epidermis becomes detached and can be peeled off. Infection usually spreads from the base of a leaf. Brownish black sclerotia 2-8 mm in size form in the hollow of the stem. Infected stems dry and become fragile. Losses result from premature stem desiccation and premature ripening of pods, leading to shedding of seed.

Sclerotia, which fall to the soil during harvesting or which remain in residues of infected plants, are a key factor in the origin of infection and spread of the disease. They may survive in the soil for 7-12 years. Sclerotia sometimes contaminate seed lots. Cup-like apothecia develop from sclerotia in April-May and release ascospores which infect the rape plants. Wet climatic conditions stimulate the formation of apothecia and prolong the period of ascospore release. Infection is favoured if spore release coincides with the stage of full flowering. Petal shedding is then at a maximum, and the fallen petals adhere to the plants in wet climatic conditions. The occurrence of such conditions can be used to determine the need for chemical treatment and the optimum application time.

Basic strategy

The most important preventive measures are: crop hygiene to prevent as far as possible sclerotia from entering the soil and from being transmitted to new localities; planting healthy seed (not contaminated by sclerotia); 4-7 year rotation of crucifers; avoiding other crops susceptible to *S. sclerotiorum* (other crucifers, potato, tobacco, soybean, beans, umbellifers, sunflower, etc.). The effect of the microclimate on fungal development within the stand depends on row width, stand density (low sowing rate) and timely eradication of weeds. Fungicides are applied at first petal fall, after a risk assessment based on climatic conditions and crop rotation, which may also include monitoring of apothecial development during flowering.

Main fungicides

Carbendazim, difenoconazole, fenbuconazole, iprodione, prochloraz, procymidone, tebuconazole, thiophanate-methyl, vinclozolin.

Botrytis cinerea (grey mould)

General

In wet climatic conditions, *Botryotinia fuckeliana* (anamorph *Botrytis cinerea*) infects rape to form grey-brown masses of mycelium, producing abundant conidia, on the surface of infected stems, branches, leaves or pods. There is a sharp line between the healthy and infected tissues on young plants, but in late infections the boundary is more diffuse, as in stem blight due to *Sclerotinia sclerotiorum*. Sclerotia form in the stem debris at a later stage than for *S. sclerotiorum*.

Infected debris in the soil is the main source of infection. The first lesions can appear on cotyledons, but the fungus mainly spreads when the winter period is over. In spring, lesions appear at points of frost injury. Later infection depends on the combination of suitable climatic conditions and damage to the plants (e.g. by larvae of seed weevils). The most usual infection site is the leaf axil. A final cycle of infection can occur on the pods. If plants are infected early (end of winter), *B. cinerea* can cause a general rot of the leaves and heart of the plant. As with *S. sclerotiorum*, damage arises especially from late infection of the stem and pods, causing premature ripening and premature shedding of seeds. Infected pods yield a lower weight of seeds. The incidence of *B. cinerea* depends very much on climatic conditions and varies from year to year.

Basic strategy

Use of resistant cultivars may, in some regions, avoid the need for fungicides. A general preventive measure against *B. cinerea* is to plant at an optimum stand density of 30-40 plants per m^2. Mechanical injury to the plants should be avoided. Application of nitrogen fertilizers should be limited, and divided into two operations in spring. In most cases, no fungicide treatments are needed. If favourable climatic conditions occur in areas where there is known to be a risk of the disease, it may be necessary to apply fungicide sprays preventively. Their effectiveness is very low if applied to control visible outbreaks.

Main fungicides

Benomyl, carbendazim, chlorothalonil, iprodione, prochloraz, thiophanate-methyl, vinclozolin.

Alternaria brassicae (black spot, dark leaf spot)

General

Alternaria brassicae can infect seedlings of rape, causing blackish brown streaks on the hypocotyls. Cultivars differ in susceptibility. Severe infection can cause damping-off. The fungus can then infect all above-ground parts of the crop at all growth stages. The most damaging infections are those on the pods (dark pod spot), which take the form of irregular, black, sharply marked blotches covered with conidia. If young pods are infected, their growth is deformed. Infected pods shrink, burst prematurely and the seeds are shed. Seeds from infected pods are usually low in weight.

Old stem and leaf debris from the previous year is the source of primary infection. Wind-borne conidia spread the disease from plant to plant. *A. brassicae* is seed-transmitted, but this is relatively unimportant in practice. Alternation between wet and dry periods favours the disease, and high temperatures (18°C) accelerate its development.

Basic strategy

The most important preventive measures are to observe a suitable crop rotation, to plough rape stubble under soon after harvest and to avoid planting rape at enclosed, damp locations. Cultivars differ in susceptibility. Fungicide seed treatments may be used to reduce the risk of primary infection. Chemical control measures may be necessary in warm humid seasons. A single fungicide application should be made after flowering, when the first spots are detected on the pods. In most regions, however, chemical control is not necessary.

Main fungicides

Sprays: difenoconazole, iprodione, procymidone, tebuconazole, vinclozolin. Seed treatments: fenpropimorph, iprodione.

Leptosphaeria maculans (phoma leaf spot, black leg, canker)

General

Primary infection of rape by *Leptosphaeria maculans* (anamorph *Phoma lingam*) occurs mainly from the seedling stage to the 6-leaf stage. Wind-borne ascospores released from pseudothecia on old stem and leaf debris from the previous year are the main source of primary infection. Seed-borne infection also occurs, but this is less important than for vegetable brassicas. The fungus then spreads by rain-splashed conidia to all parts of the plant, causing greyish papery spots in which black pycnidia are visible. Plants infected in early autumn can develop cankers at the base of the stem, which may lead to death of the plant in winter or to lodging in the spring. The fungus continues to spread on the leaves and pods, causing losses mainly due to premature splitting of pods and seed shedding. Secondary spread is favoured by stem attacks of *Ceutorhynchus napi* and *C. pallidactylus*, and it is therefore important to control these pests. Seeds from infected pods are usually low in weight.

Basic strategy

Preventive methods include appropriate crop rotation, optimum stand density (30-40 plants per m^2), ploughing in rape stubble soon after harvest, growing resistant cultivars. Fungicidal seed treatments may be used to reduce the risk of primary infection. In autumn, or at growth stage 31-51, fungicidal sprays may be applied if the infection level reaches a threshold value (e.g. 35-45% of plants infected). Maturation of ascospores can be monitored on crop debris placed in the field. When rain is followed by ascospore release, treat within the next few days.

Main fungicides

Benomyl, flutriafol, thiabendazole, thiophanate-methyl, thiram (as seed treatments). Carbendazim, difenoconazole, prochloraz, tebuconazole (as sprays).

Peronospora parasitica (downy mildew)

General

Downy mildew is common on rape but not usually very damaging. It mainly affects rape at the seedling stage. Infection appears first on the cotyledons as yellow speckled patches on the upper leaf surface with corresponding white fungal growth on the under surface. The fungal growth comprises sporangiophores bearing sporangia which spread the disease. Severely infected seedlings are stunted or killed. Leaf symptoms on older plants appear as less well defined yellowish brown areas between the main veins, with white to grey fungal growth beneath. Symptoms on pods consist of irregular brown to black speckling with sparse fungal growth. Severely affected leaves may senesce prematurely. The fungus forms oospores in affected tissue which can survive in soil or debris for many months or years and be a major source of inoculum.

Basic strategy

Treatment in the field is rarely necessary. Seed treatments may be used in areas of high risk. If damaging infection is seen in the field, foliar sprays may be applied. Cultural methods include crop rotation to avoid build-up of the soil-borne phase and reduction of the favourable conditions afforded by, for example, humid sheltered sites and closely spaced plants.

Main fungicides

Benalaxyl, mancozeb, metalaxyl, thiram.

Erysiphe cruciferarum (powdery mildew)

General

Powdery mildew can affect rape but is not usually damaging. The fungus can only survive on green tissue; therefore affected brassica crops provide the main source of infection. The first signs of infection are patches of thin white mycelium radiating out sparsely on either leaf surface. This can develop into a much denser mat of white powdery growth covering parts of, or the whole, leaf surface.

The disease is spread by wind-borne conidia from infected tissue; cleistothecia may also be present. It is typically more severe in warm dry summers with temperatures of 15-20°C during periods of high humidity.

Basic strategy

No control is normally needed.

Pyrenopeziza brassicae (light leaf spot)

General

Pyrenopeziza brassicae (anamorph *Cylindrosporium concentricum*) spreads particularly in wet climatic conditions in winter or in autumn. White blotches with concentrically arranged rings of conidia appear on leaves. If the infection rate is high, the leaves dry off and the infection is transmitted to flower buds, which then turn brown. The pods can also be damaged and deformed, and can thus burst prematurely.

Infection by *P. brassicae* appears in autumn, and can cause great damage in mild winter periods, but the symptoms on leaves and stalks are not usually seen before spring. Conidia, and possibly ascospores, formed on debris are the main primary inoculum. Applications of herbicides that destroy the protective waxy layer on the surface of the rape plant can increase the probability of infection.

Basic strategy

Cultivars of low susceptibility are available and should preferably be used. Infected debris should be ploughed under. In case of infection, fungicide sprays can be applied in the autumn, at the time of regrowth in the spring or at the beginning of flowering. A suitable threshold is 20% of plants infected.

Main fungicides

Carbendazim, fenbuconazole, flusilazole, flutriafol, iprodione, prochloraz, propiconazole, tebuconazole.

Pseudocercosporella capsellae (white leaf spot)

General

Pseudocercosporella capsellae causes light-coloured lesions with a dark border on leaves and stems of rape. It is widespread in the wetter areas of western Europe and persists in the soil as small sclerotia. The primary inoculum is from conidia, and possibly ascospores, formed on plant debris. It can spread to the pods under very wet conditions and cause losses in grain yield because of pod splitting.

Basic strategy

Fungicide sprays can be used at the time of regrowth in the spring or at flowering if there is a high risk of infection. Some cultivars are less susceptible.

Main fungicides

Carbendazim, difenoconazole, fenbuconazole, flusilazole, flutriafol, iprodione, prochloraz, tebuconazole.

Damping-off diseases

General

Rape is susceptible to the fungi which cause damping-off in many other crops, including vegetable brassicas, i.e. mainly *Pythium* spp. and *Thanatephorus cucumeris* (anamorph *Rhizoctonia solani*). Seedlings may be killed before emergence, causing thinning of the stand, or may show rotting of the stem base after emergence. The fungi concerned survive in the soil or on other host plants. Infection is favoured by cold wet conditions. Factors which stress or check plant growth will favour attack.

Basic strategy

Crop rotation, adequate drainage and avoidance of sowing or planting in cold wet soils should aid prevention of damping-off. Seed treatments can provide early protection of seedlings.

Main fungicides

Seed treatments: against *Pythium*, metalaxyl, thiram; against *R. solani*, thiram.

Plasmodiophora brassicae (club root)

General

Infection of rape by *Plasmodiophora brassicae* can be important in areas where crucifer crops are frequently planted. Infection appears in autumn, as "clubs" formed

on the main roots and at the base of the plant (similar to the injuries caused by larvae of *Ceutorhynchus assimilis*). In spring, the clubs disintegrate into slimy masses. The development of infected plants is retarded, their yield is lower and, in extreme cases, they are killed in winter. Club root is most severe on acid soils.

Basic strategy

The recommended preventive measures are liming (to increase the pH if possible above 6.5), suitable crop rotation and control of cruciferous weeds. Though chemical treatments may in some cases be feasible on vegetable brassicas, they are not economic or useful on rape.

Virus diseases

General

Several viruses affect rape (*Beet western yellows luteovirus*, *Cauliflower mosaic caulimovirus*, *Turnip mosaic potyvirus*) and are transmitted by the aphids *Myzus persicae* and *Brevicoryne brassicae.* They can cause stunting and loss of yield. Early season virus transmission by *M. persicae* is much the most important.

Basic strategy

If infestation of *M. persicae* is seen very early (between the cotyledon and 6-leaf stages), it may be useful to apply a spray treatment. A suitable threshold is 20% of plants infested.

Main insecticides

Deltamethrin, dimethoate, esfenvalerate, ethiofencarb, fenitrothion, lambda-cyhalothrin, malathion, methomyl, phosalone, phosphamidon, pirimicarb.

Psylliodes chrysocephala **(cabbage stem flea beetle)**

General

Attacks by *Psylliodes chrysocephala* on rape are localized and occasionally damaging. The adults lay in the soil. The larvae tunnel into the leaf petioles and stems in early autumn, or during the winter (if mild). Plant may be killed but usually only vigour is affected. This pest is very common in areas where there is a high density of rape. Adults can also make holes in the leaves of young seedlings and damage can be severe if growth is slow.

Basic strategy

Seed treatments may be used to protect young seedlings against direct damage from adults and to reduce numbers of adults and eggs. Adult flight can be monitored by trapping. Where adult damage is severe, a pyrethroid spray can be applied. The young plants can then be monitored for presence of larvae and a downward spray application made in the autumn if a threshold is exceeded (2-5 larvae per plant, according to the area and the development of the crop). Thresholds have also been set for treatment in spring (e.g. 3 larvae per main stem; 10% of destroyed leaf area destroyed at BBCH-growth stage 09-10 (emergence to complete unfolding of cotyledons; 50 adults per trap in 3 weeks at BBCH-growth stage 14-16 (4-5 leaves unfolded). Usually only a single application is needed. Control of *P. chrysocephala* will also control minor pests such as *Phytomyza rufipes* (cabbage leaf miner) and *Chromatomyia horticola* (garden pea leaf miner).

Main insecticides

Carbofuran, carbosulfan, lindane, mercaptodimethur (seed treatments). Beta-cyfluthrin, bifenthrin, carbofuran, fenvalerate, lindane, mercaptodimethur, parathion, pirimiphos-methyl (row treatments against larvae). Alpha-cypermethrin, beta-cyfluthrin, bifenthrin, cypermethrin, deltamethrin, lambda-cyhalothrin (sprays).

Phyllotreta **spp. (flea beetles)**

General

Phyllotreta spp. are widespread and often serious pests of rape seedlings, especially spring rape. Damage can also be severe on winter rape in dry weather conditions.

Basic strategy

The seedbed should be well prepared, moist and with adequate fertilizers. This will ensure rapid germination and help seedlings grow quickly through the susceptible stage. Insecticides may be used as seed treatments, or as sprays, in dry weather conditions, at the first sign of damage; a single application is normally sufficient.

Main insecticides

Isofenphos, mercaptodimethur (seed treatment). Deltamethrin, fenvalerate, lambda-cyhalothrin, phosalone (sprays).

Ceutorhynchus pleurostigma **(turnip gall weevil)**

General

Centhorhynchus pleurostigma lays its eggs at the collar of young rape plants, and causes the development of

galls containing the larvae. Damage is not normally severe, but some premature stem breaking may occur.

Basic strategy

Rotation with non-cruciferous crops is the main preventive method. Insecticides can if necessary be applied as a seed treatment (lindane) or row treatment (carbofuran).

Ceutorhynchus napi **(cabbage stem weevil)**

General

The stems of rape are damaged by larvae of *Ceutorhynchus napi*. Adults hibernate in the soil of fields where rape was grown in the preceding season. They migrate when soil temperature reaches 6°C at a depth of 2 cm, and begin to attack new rape stand at temperatures of 9-12°C. *C. pallidactylus* (= *C. quadridens*) (lesser cabbage stem weevil) causes similar damage, but mainly on spring rape.

Basic strategy

Crop rotation with non-cruciferous crops is the main preventive method. Insecticide sprays may be applied if adult populations exceed a certain threshold (e.g. 25 or more adults during 3 days on 4 yellow dishes). This threshold value depends very much on the region and in some places 25 could be too low.

Main insecticides

Alpha-cypermethrin, cypermethrin, deltamethrin, esfenvalerate, fenvalerate, lambda-cyhalothrin, permethrin.

Meligethes aeneus **(pollen beetle)**

General

Adults and larvae of *Meligethes aeneus* damage the bases of rape flowers. The adults hibernate in forests and grasslands and migrate when the day-time temperature reaches 10-11°C ; longer distance migration occurs when the temperature reaches 15°C.

Basic strategy

Forecasts can be made of the times of likely migration of *M. aeneus* on the basis of days above 8°C early in spring and/or of monitoring by trapping. Sprays of pyrethroid insecticides will give some control but they should be applied according to an appropriate threshold of adult numbers per plant, which varies between different areas depending on the phenological stage of the plant at the time of invasion. In central Europe, typical thresholds are, on a normally developed crop: 3-4 adults per plant at BBCH-growth stage 51 (flower buds visible from above), 7-8 adults per plant at BBCH-growth stage 52-53 (flower buds free, at the level or raised above the youngest leaves), >8 adults per plant at BBCH growth stage 55-59 (individual flower buds visible but still closed, to first petals visible). On a poorly developed crop, the corresponding figures would be lower (over range 1 to 5). Treatments should be applied before most flowers have opened, and it is generally of no value (and not GPP) to spray during or after flowering. If chemical control is required, it may be sufficient in areas where density of the pest is moderate to treat only a strip 25-50 m wide around the field. In areas of high pest density, the whole field should be sprayed. The insecticides used and the time of application (during the day) should be safe for bees.

Main insecticides

Alpha-cypermethrin, cyfluthrin, cypermethrin, deltamethrin, esfenvalerate, fenvalerate, lambda-cyhalothrin, tau-fluvalinate.

Ceutorhynchus assimilis **(cabbage seed weevil)**

General

The adults of *Ceutorhynchus assimilis* feed on and lay in the young pods of rape and the larvae then damage the seeds in the pods. *C. assimilis* is most dangerous if temperatures are high during flowering. Infestations are often concentrated at the borders of fields.

Basic strategy

Chemical control is the only option and is advised only after first pod formation, when a suitable threshold is reached (e.g. 0.5-2 adults per plant, according to region, at the edge of the field). Several counts should be made during flowering. Generally, a single treatement is sufficient. It is not useful to treat after the end of flowering. Counts can be made separately at the edge and centre of the field, allowing treatment of the border only, in appropriate cases.

Main insecticides

Alpha-cypermethrin, bensultap, cypermethrin, deltamethrin, esfenvalerate, lambda-cyhalothrin, methidathion, phosalone.

Dasineura brassicae **(brassica pod midge)**

General

Adults of *Dasineura brassicae* lay in holes in young pods, especially those made by feeding or laying of *Ceutorhynchus assimilis.* The larvae damage the seeds and cause pod splitting and therefore seed loss. *D. brassicae* hatches when the temperature is more

then 13°C. A proportion of the total number of larvae hibernate and survive in soil for 1-5 years. Infestations are often concentrated at the borders of fields.

Basic strategy

Because *D. brassicae* follows *C. assimilis* in infesting pods, it is often sufficient just to control *C. assimilis.* If a risk of infestation does arise (e.g. if damage from *C. assimilis* is seen), spray treatments may be applied on the basis of temperature criteria and trapping of adults.

Main insecticides

Alpha-cypermethrin, beta-cyfluthrin, cypermethrin, deltamethrin, lambda-cyhalothrin, methidathion.

***Brevicoryne brassicae* (mealy cabbage aphid)**

General

Aphids are important and widespread pests of rape. Heavy infestations cause distortion of leaves and pods and may check plant growth. The seeds from affected pods are usually low in weight.

Basic strategy

Chemical control is sometimes necessary, after the end of flowering, using selective insecticides, preferably those which are not harmful to natural enemies of the aphids. Thresholds can be used to determine the need to treat (e.g. two colonies per m^2 at the edge of the field).

Main insecticides

Deltamethrin, dimethoate, esfenvalerate, ethiofencarb, fenitrothion, lambda-cyhalothrin, malathion, methomyl, phosalone, phosphamidon, pirimicarb.

***Athalia rosae* (Japanese cabbage sawfly)**

General

Athalia rosae is an occasional pest of winter rape, especially in central and eastern Europe. A first flight occurs in April (but does not give rise to any damage) and a second from mid-August until the end of September or beginning of October. Adults of the second flight lay their eggs in the leaf tissue of young plants. Embryonic development takes 7-10 days. The young larvae (pseudocaterpillars) peel the underside of leaves or chew out small holes. The larvae of the 4-5th stages can be found on the upper surface of the leaves, where they chew out the tissue between the veins. In the case of strong infestation, only the thick veins and stumps of stems remain. The pest overwinters in the soil in the pupal stage.

Basic strategy

A. rosae can be monitored by the use of Moericke yellow dishes. Eggs laid in leaf parenchyma can be seen by shining a light through the leaves of emerging rape plants. Insecticide sprays can be applied if the number of L_1/L_2 larvae exceeds a certain threshold, e.g. 2 per plant.

Main insecticides

Deltamethrin, lambda-cyhalothrin, methidathion, phosmet, triazophos.

Slugs

General

Slugs (e.g. *Agriolimax arvensis*, *Deroceras reticulatum*) damage rape seedlings and sometimes feed on established plants. They are largely a problem on medium to heavy textured soils in wet seasons, or after non-cropped fallow land, causing most damage in the late spring and autumn.

Basic strategy

A firmly consolidated seedbed will restrict slug movement and encourage rapid seedling growth. To assess the risk of slug damage and the need for and time of molluscicide treatments, test baiting when the soil surface is moist is advised. The normal method of treatment is to scatter molluscicide formulated as a bait.

Main molluscicides

Mercaptodimethur, metaldehyde.

Nematodes

General

Heterodera cruciferae, *H. schachtii*, *Meloidogyne artiellia*, *Trichodorus* spp., *Paratrichodorus* spp. and *Longidorus* spp. attack rape, but attacks are localized and only occasionally damaging. Rape may act as a bridge for *H. schachtii* between crops of sugarbeet. Attacks by the free-living species are largely confined to lighter soils.

Basic strategy

The normally recommended crop rotation for rape should control nematode populations. The use of nematicides in other crops in the rotation (e.g. potatoes) may control the free-living species in particular. It is not GPP to apply nematicides specifically to control nematodes in rape.

Weeds

General

Herbicides are applied in rape fields principally against annual dicotyledonous weeds but also to control annual monocotyledonous weeds, threatening the establishment and early growth of the crop. Particular problems are *Matricaria* spp., *Galium aparine, Apera spica-venti* and cereal plants derived from the previous crop. In general, winter rape competes well with weeds and allows for relatively high numbers of weeds before herbicide control becomes economically profitable. On spring rape, seed-bed cultivation destroys most emerging weeds, so weed pressure is often less than on winter rape.

Basic strategy

It is in principle possible to control weeds in rape mechanically, but this is not widely practised. Some of the most troublesome weeds should be controlled elsewhere in the crop rotation (e.g. *Galium aparine, Elymus repens*). The recommended GPP for winter rape is to choose a combination of herbicides which will give cost-effective control of the most competitive species. Pre-sowing applications can be done before tillage or in the stubble of the previous crop. Pre-emergence herbicides are appropriate only if certain specific difficult weeds are present. Herbicides are usually applied post-emergence, because this allows assessment of the weed problem and evaluation of the cheapest and most effective solution. Removal of broad-leaved weeds in a vigorous crop may not always be cost-effective. In spring rape, treatments may not always be necessary. Otherwise, a single pre-emergence application is usually all that is required.

Main herbicides

Pre-sowing

Without tillage: glufosinate-ammonium, glyphosate. After tillage, napropamide, tri-allate, trifluralin.

Pre-emergence

Alachlor, dimethachlor, metazachlor, propachlor, quinmerac, tebutam.

Post-emergence

Against grasses: alloxydim-sodium, cycloxydim, diclofop-methyl, fluazifop-P-butyl, haloxyfop-ethoxyethyl, quizalofop-ethyl, sethoxydim.

Against grasses and dicots: carbetamide, dimefuron, metazachlor, propyzamide.

Against dicots: benazolin, clopyralid, cyanazine, quinmerac.

Desiccation

General

The aim of desiccation in rape is to kill all leaves and stems at a suitable time for better harvest, and to control weeds which may interfere with harvesting. Because desiccation may cause loss of grain, it is not generally recommended, but can be used when there is a problem of uneven ripening or weed infestation. Growth regulators have also been recommended for stem strengthening and lodging control in rape, but are now little used.

Basic strategy

The timing of desiccation is important to minimize losses. A suitable recommendation is, for example, when 70% of pods turn yellow and some seeds are brown (usually 4-5 days before harvest).

Main desiccants

Diquat, glufosinate-ammonium, glyphosate.