HGCA
Oilseed rape guide

HGCA

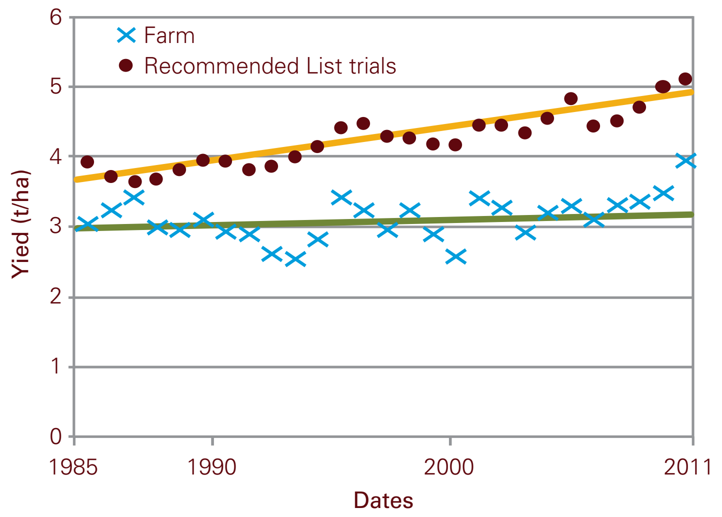
AHDB Agriculture & Horticulture DEVELOPMENT BOARD

Updated January 2014

Introduction

Average oilseed rape yields on-farm have increased only very slowly since the early 1980s, even after accounting for the very high yields achieved in 2011 (Figure 1). By contrast, the yield of new varieties measured in the HGCA Recommended List trials have increased by 0.05 t/ha per year (Figure 1). This has resulted in a widening gap between the potential yield of new varieties and the yields achieved on-farm. It is likely that a significant cause of the increasing differences between Recommended List trial yields and average farm yields is suboptimal crop management.

Figure 1. Oilseed rape yields for farm and Recommended List trials.



Estimates of the potential yield for the UK are greater than 6.5 t/ha so there is still significant scope to increase both the potential yield of new varieties and the yields achieved on farms. This was demonstrated in 2011 when the average farm yield was 0.8 t/ha above the long-term average of 3.1 t/ha. There were several reasons for the high yields in 2011, including:

- Consistent plant establishment with few bare patches
- A dry spring restricting crop growth and enabling crops to achieve the optimum canopy size
- A sunny spring which helped to set more seeds per pod and increased the rate of early seed fill
- A cool summer which prolonged seed filling
- Low disease levels due to a combination of good control with fungicides and weather conditions that were not conducive to disease development
- Improved technical expertise

The higher than average yields of 2011 give hope that greater yields can be achieved on a regular basis. This guide describes the best crop management for oilseed rape to maximise profit margins through the best possible yields for the growing environment.

HGCA and Defra's yield plateau study (HGCA Project Report 502) addressed the lack of progression in UK average farm yields for wheat and oilseed rape by analysing national yield trends and farm-specific data.

The aims of this study were to identify agronomic factors that may be constraining oilseed rape yield improvement, assess the scope and opportunities for raising national yields through agronomy and highlight knowledge gaps or barriers to be addressed.

No single agronomic factor was shown to have had a clear dominant effect on trends in oilseed rape yields over the last 30 years.

There was evidence that the rise in oilseed rape cropping frequency is limiting oilseed rape yields. The proportion of the English oilseed rape crop grown after a break of four or more years has declined from 90% at the end of the 1980s to less than 50%. If this proportion declines further, the incidence of soil borne disease is likely to increase and the yield effects could be significant.

Uptake of new, high-yielding oilseed rape varieties was poor prior to 2004, with growers selecting varieties that were easier to manage and harvest ahead of the highest yielding varieties. Since 2004, this trend has been reversed to some degree.

The project found that the average amount of fertiliser N applied to oilseed rape has fallen from about 270 kg N/ha in 1983 to a current level of 180–190 kg N/ha. It is uncertain if the N requirement of modern varieties has risen with yield potential but some data hints that current amounts of spring N applied to oilseed rape are suboptimal. There is also evidence that insufficient use of sulphur (S) fertiliser has limited yields in the past and while it is recommended that all oilseed rape crops now receive S, only 60–70% of crops are currently treated and rates may be suboptimal. Applications of phosphate (P) and potash (K) fertilisers to oilseed rape have fallen since the mid-1990s but there is no evidence that suboptimal P and K are limiting yields; however this situation may change as many farms are currently running P and K deficits.

To maintain rising yields in the face of agronomic, economic and environmental pressures, a more holistic approach is needed. Recommendations include improved selection and management of varieties and a focus on improving N and S use efficiency. Benchmarking of yields, resources to 'health check' cropping systems and increased utilisation of survey data are vital to guide and measure change.

The full project report can be downloaded from **www.hgca.com/publications** – search for PR502.

Contents

Markets and variety selection

Oilseed rape UK planting area

The area planted in the UK reached a new record in 2012. The long-term increase in the area in Great Britain stands at 737,000 hectares for harvest 2012. The increase in the area of oilseed rape planted in the UK over recent years has been a response to historically high prices.

Demand for rapeseed oil in biodiesel has been strong and supply has been disrupted by unfavourable weather patterns in central Europe. While weather may return to more favourable patterns, the demand potential for rapeseed oil in biodiesel remains strong. Official mandates for biodiesel blending in fuels are currently legislated until 2020.

Exports

From a UK perspective, the strong demand from Europe supports the oilseed rape price as well as providing a potential export market. During the 2011/12 season, exports of rapeseed are set to hit a new record. Surplus production from the 2010 and 2011 harvests was easily exported into a rapeseed-hungry Germany. If mainland European biodiesel demand remains strong, the UK will continue to be in a prime position to export surplus rapeseed and rapeseed oil to major European consumers.

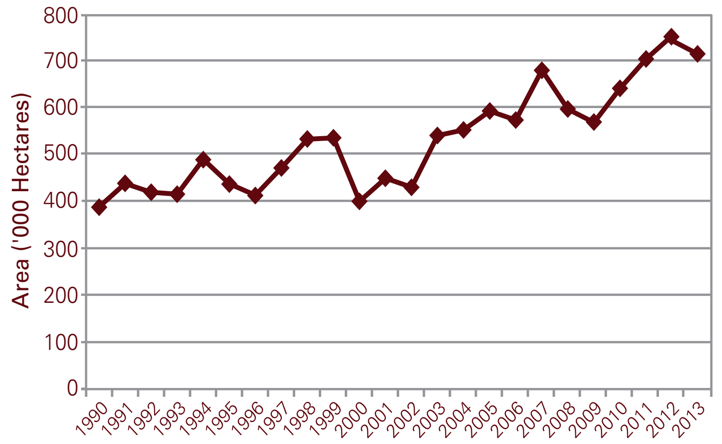
Global markets

While the European perspective is very important to the UK rapeseed market, it is unwise to discount the impact of the global oilseed market. Over recent years, there has been a large increase in global oilseed demand derived from both protein meal used in animal feed and vegetable oil for biodiesel and human consumption.

Supply disruption in the main soya bean-producing areas – for example, Argentina's drought-hit crops in 2008 and 2012 – has created a period of price volatility that has affected the European and UK rapeseed market.

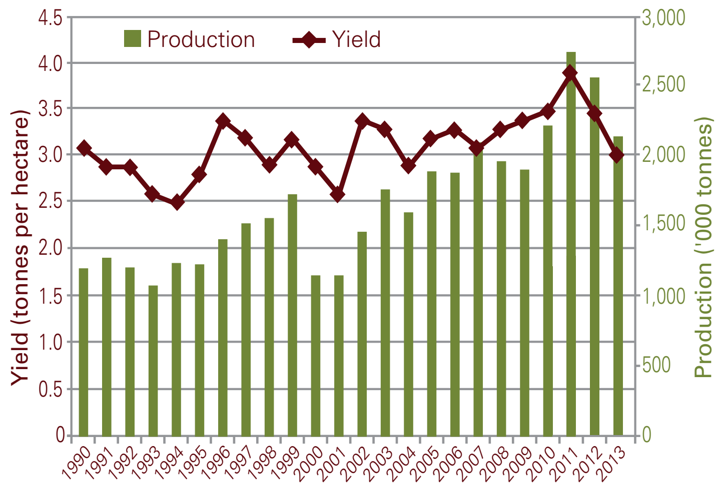
The global demand outlook for oilseeds remains firm due to economic and population growth in the emerging economies of Asia – notably China and India. The question is whether supply can respond sufficiently to meet this demand. Any disruptions to supply will see volatile market reactions that will impact on rapeseed markets.

Figure 2. UK oilseed rape area, 1990-2013.



Source: AHDB/Defra

Figure 3. UK oilseed rape yield and production, 1990-2013.



Source: AHDB/Defra

More market information from HGCA

Newsletters (email or fax)

Market Report – a weekly overview of the main stories, prices and exchange rates

MI Prospects – a fortnightly newsletter with a more in-depth look at the latest market analysis and outlooks

Email **subscriptions@hgca.ahdb.org.uk** or phone **024 7647 8730** to sign up.

Twitter

Follow HGCA on Twitter for the latest market developments **Twitter.com/HGCA_tweet**

Website

Keep up to date with the latest prices and news at **www.hgca.com/markets**

Mobile website

Access market information on your mobile phone at **www.hgca.com/mobile**

Variety selection

Gross output (yield adjusted for oil content) is usually the most important factor for variety selection. Other important agronomic factors include resistance to lodging, resistance to diseases and maturity date.

The HGCA Recommended List rates winter oilseed rape varieties for:

- Gross output
- Resistance to lodging
- Stem stiffness
- Shortness of stem
- Earliness of flowering
- Earliness of maturity
- Oil content
- Glucosinolate content
- Resistance to light leaf spot
- Resistance to phoma stem canker

HGCA also produces a Descriptive List for spring oilseed rape, which considers gross output, oil and glucosinolate content, standing ability, shortness of stem, earliness of flowering and earliness of maturity.

Conventional open-pollinated varieties

- Also known as 'pure lines' or 'inbred lines'
- Self-pollinating
- Home-saved seed will result in plants with the same characteristics as the original parent

Inbred production relies on crossing parent lines and then purifying the lines to ensure each plant has the same characteristics.

Clearfield®

The Clearfield® oilseed rape production system brings together specific herbicides with herbicide-tolerant hybrid varieties. The hybrid varieties are bred using a traditional, non-GM, technique.

Hybrid varieties

- Also known as 'restored hybrids'
- Yields are comparable to conventional varieties
- Often sown at a lower seed rate than conventional varieties
- Cannot be home-saved

Hybrids are more expensive to produce than conventional varieties. They are produced by crossing a male-sterile 'female' plant with a pollen-producing 'male' plant. This restores the pollen-producing ability in the resultant seed. Hybrid production enables a wide range of characteristics to be incorporated into a new variety, potentially increasing the adaptability of the variety to a range of growing conditions.

Semi-dwarf hybrid varieties

These varieties are believed to contain the *Bzh* dwarfing gene, resulting in short, stiff varieties that have less lodging, making them easier to harvest. Yields are not currently at the same level as conventional varieties or hybrid varieties not containing this dwarfing gene.

Varieties for specific markets

High erucic acid rape (HEAR)

HEAR varieties are used in industrial processes, such as inks, lubrication and as a slip agent in the production of polythene.

High oleic, low linolenic (HOLL)

HOLL oilseed rape oil is a low trans fatty acid and low saturated fat vegetable oil that is stable and performs well at high temperatures. All HOLL rapeseed is currently grown under contract to ensure quality of supply and full traceability.

- Keep volunteers and weeds to a minimum
- A gap of three years is recommended between standard and HOLL rapeseed crops
- HOLL varieties should not be grown on land previously used for HEAR varieties
- Take measures to avoid any contamination at harvest and during storage and transport

More variety information from HGCA

Publications

Variety information is available as the A4 Recommended Lists booklet or as Pocketbooks. Email **hgca@cambertown.com** or phone **0845 245 0009** to order a copy.

Website

For the latest variety information, visit **www.hgca.com/varieties**

Use the RL *Plus* tool to sort varieties by the characteristics most important to you **www.hgca.com/varieties/rl-plus**

Mobile website

Access variety information on your mobile phone at **www.hgca.com/varieties/mobile**

Harvest Results

Throughout the harvest, yield data from the RL trials is made available by email or fax.

Email **subscriptions@hgca.ahdb.org.uk** or phone **024 7647 8730** to sign up.

RECOMMENDED HGCA

Winter oilseed rape manage

Summer | Autumn | Winter

Growth stage

- Cultivations and sowing
- Leaf production

Variety, seed rate, nutrition and PGRs

Planning

- Choose variety, establishment method and seed rate
- Check SNS and plan N applications

Action

- Autumn P, K and N applications

Diseases

Planning

- Consider soil-borne diseases; choose variety and seed treatment
- Monitor phoma leaf spot and light leaf spot for spray thresholds

Action

- Phoma leaf spot sprays
- Light leaf spot sprays

Weeds

Planning

- Assess weed risk; decide cultivations and pre-emergence herbicides
- Monitor for cereal volunteers
  Check timing restrictions on graminicide sequences with other herbicides
- Monitor soil temperatures in preparation for propyzamide/carbetamide applications

Action

- Pre-emergence herbicides
- Post-emergence herbicides

Pests

Planning

- Assess pest risks
- Monitor slugs and flea beetles for control thresholds

Action

- Flea beetle and aphid sprays
- Slug control

Summer | Autumn | Winter

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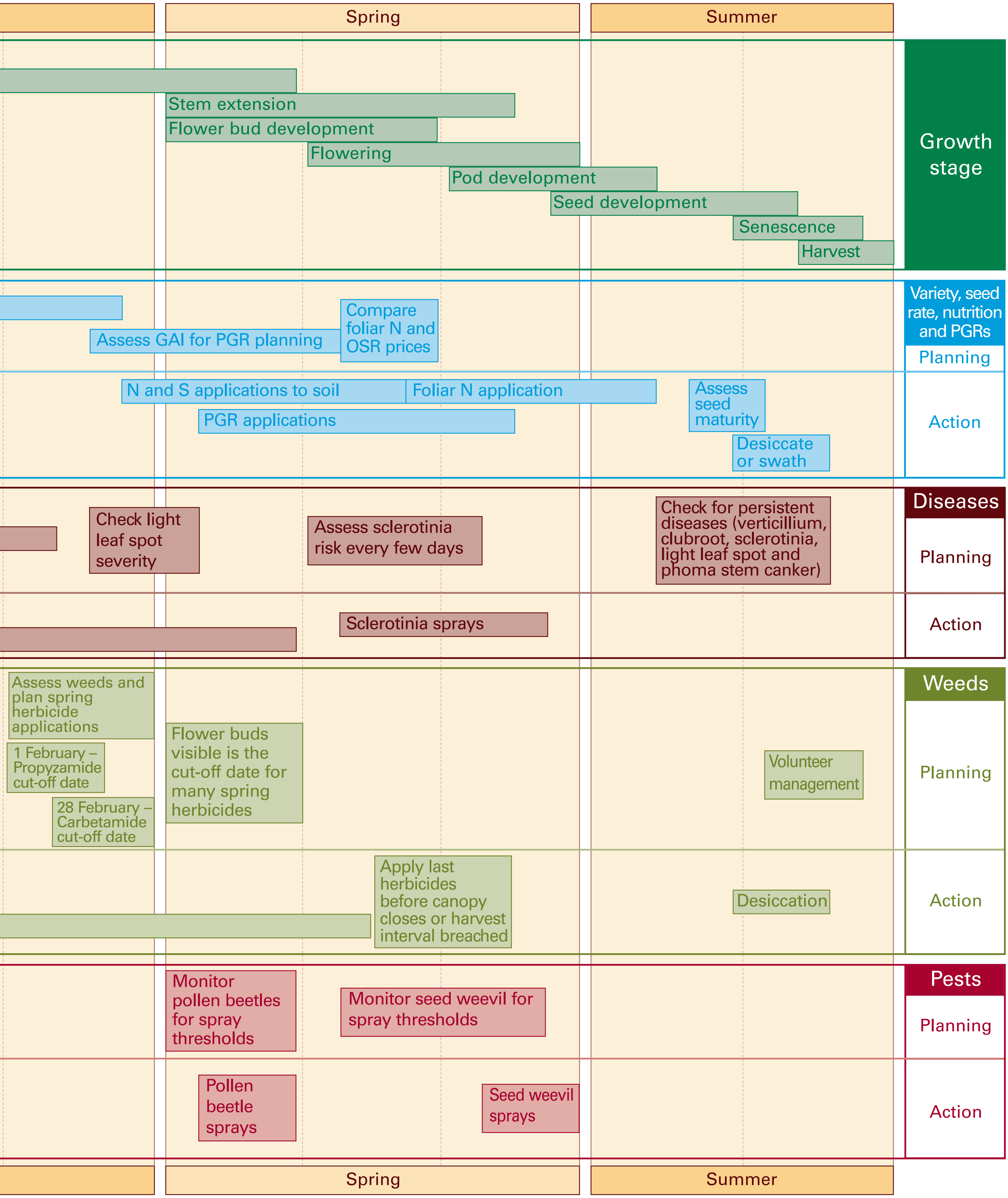


The timings for growth stages and treatments described above are approximations and will vary from field to field.

Determination of yield

Seed number

Oilseed rape yield is determined by:

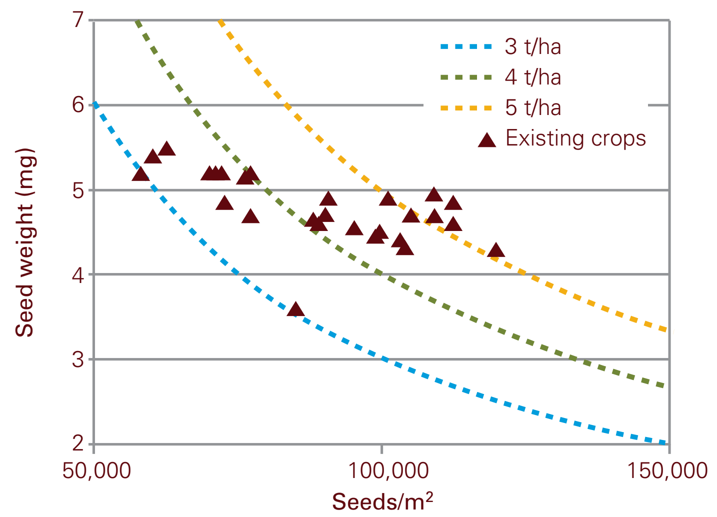
the number of seeds per m²
and
the weight of each individual seed

Crops should be managed to maximise both these components but the particular focus should be on **seed number**, as this is the more flexible of the two and the most critical for achieving a high yield.

An analysis of UK crops indicates that oilseed rape must produce at least 100,000 seeds/m² in order to achieve a yield of 5 t/ha (Figure 4).

Seed number is determined by the amount of photosynthesis carried out by the crop during a 19-25 day period after mid-flowering.

Figure 4. Seed number (seeds/m²) and seed weight (mg) observed for oilseed rape crops, and combinations of seed number and seed size required to achieve a yield of 3, 4 or 5 t/ha.

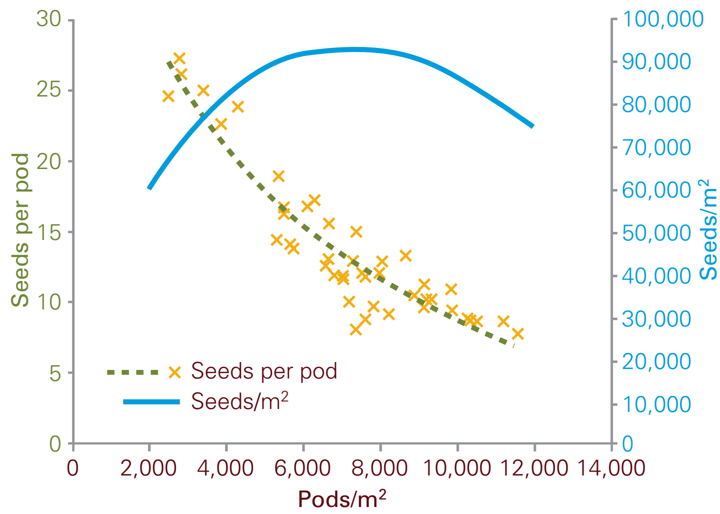


Pod number

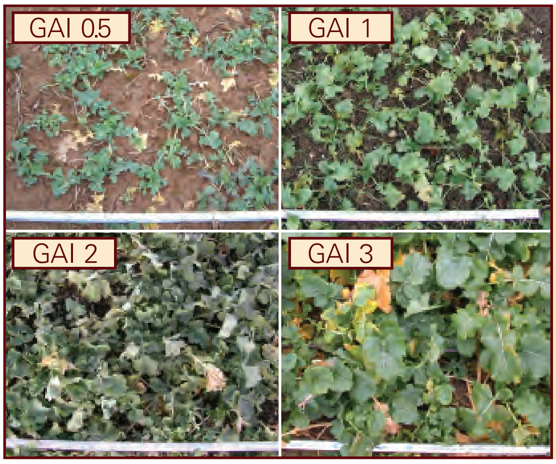
It is a common misconception that large numbers of pods are required to maximise seeds/m². HGCA research has demonstrated that **seed number is maximised by achieving an optimum pod number of 6,000 to 8,000 pods/m²** (Figure 5).

Producing excessive pod numbers of more than 10,000 pods/m² does not maximise seeds/m² because these crops tend to produce very thick flowering canopies, which can reflect and intercept up to 60% of the incoming light. This poor light use efficiency reduces the rate of photosynthesis during flowering which reduces seed set and results in few seeds per pod (Figure 5).

Figure 5. The effect of pod number on the number of seeds per pod and seeds/m².



Achieving an optimum green area index at flowering and during seed filling of 3.5 will generally maximise seed number.



Green Area Index (GAI)

Green Area Index is the ratio of green leaf and stem area to the area of ground on which the crop is growing.

GAI can be assessed by:

– Comparing the crop to reference photos

– Uploading photos of the crop to **www.totaloilseedcare.co.uk**

– Cutting all the crop from 1 m² ground, measuring the fresh weight (in kg) and multiplying by 0.8.

The latter method is most appropriate for crops with large GAIs of 3 or above.

Seed filling

The potential yield set by producing a large number of seeds can only be realised if the seeds are completely filled.

Seed growth is determined by: the length of the seed filling period and the rate of photosynthesis during this period

Seed filling lasts for a specific period of thermal time which means that cooler conditions extend seed filling (Figure 6).

Factors that curtail the seed filling period, such as drought, disease or early desiccation, can reduce oil concentration in the seed. This is because the majority of oil is accumulated during the second half of seed filling (Figure 7).

Figure 6. The effect of temperature on the duration of seed filling.

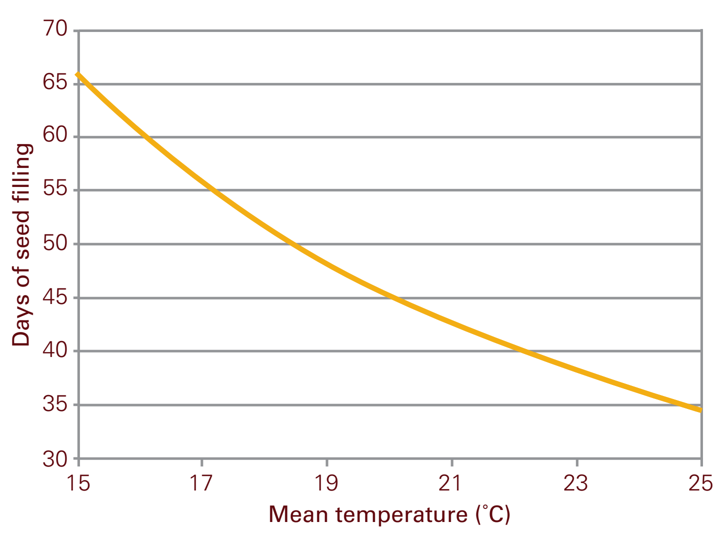
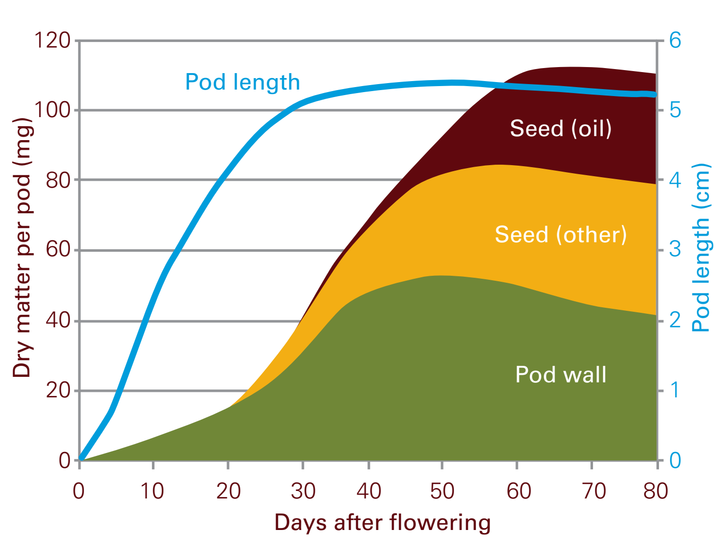


Figure 7. Pod length and typical biomass and oil accumulation in the pod wall and seed from flowering.



After Mendham and Salisbury (1995)

Although the seed may represent only about 35% of total dry matter by harvest, it represents around 50% of the total energy content because it contains a high proportion of energy-rich oil. Typically, 35% of the total crop biomass is in the stem and 30% is in the pod wall. Even for a semi-dwarf variety, stems make up about 33% of the biomass.

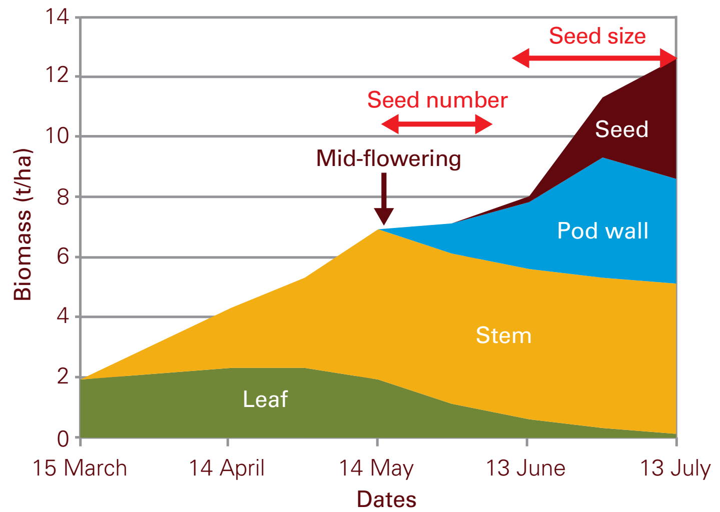
The rate of photosynthesis during seed filling is strongly affected by the canopy structure. Lodging can reduce yield by up to 50%, primarily by reducing light penetration to the lower green tissue.

Leaves have a greater photosynthetic rate than pods and stems, so prolonging leaf life and producing an unlodged, open canopy structure that allows light to penetrate to the leaves are important for maximising the photosynthesis of the whole canopy.

In oilseed rape, seed filling is determined almost entirely by current photosynthesis: up to 10% of oilseed rape yield comes from the remobilisation of soluble carbohydrate accumulated in the stem before flowering (Figure 8), compared to 20 to 50% in wheat. This means that **oilseed rape is more sensitive to poor seed filling conditions, such as drought during the critical period, than wheat.**

Deep rooting to beyond one metre soil depth is very important for maximising seed filling in dry conditions. An HGCA survey (PR402) has shown that 50% of oilseed rape crops may have insufficient roots below a depth of 40 cm with which to extract all available water.

Figure 8. Biomass accumulation in a typical oilseed rape crop and key periods for determination of seed number and seed size.



Rotation planning

Field selection

Oilseed rape will grow on a wide range of soils. Growth is often restricted by:

– Poor drainage

– Soil compaction

– Soil pH of less than 5.5

Oilseed rape is more sensitive to soil compaction than cereals. Soil compaction restricts rooting, which can reduce nutrient and water uptake. Check problem areas in fields by digging inspection pits and correct using cultivations at the appropriate depth to alleviate compaction.

Rotation planning

Growing oilseed rape in a cereal rotation offers:

– An effective break as an entry to higher-yielding first cereal crops, providing grass weed and volunteer cereal control is good

– An opportunity to control resistant grass weeds through alternative chemical control methods

– Early drilling and harvesting to spread workload

Winter oilseed rape was initially grown in one in five rotations with cereals. Economic pressures have led to shorter rotations of one in two or one in three becoming more common; there are concerns that this may have contributed to static national yield trends. The first oilseed rape crop on a field often gives a greater yield than subsequent crops, indicating that the frequency of oilseed rape in a rotation may have an important effect on yield.

The impact of short rotations

The impact of short rotations has been investigated in an eight-year HGCA project (Project Report 519) at Morley, Norfolk. Oilseed rape and winter wheat were grown at various frequencies at a trial site that had no history of oilseed rape being grown.

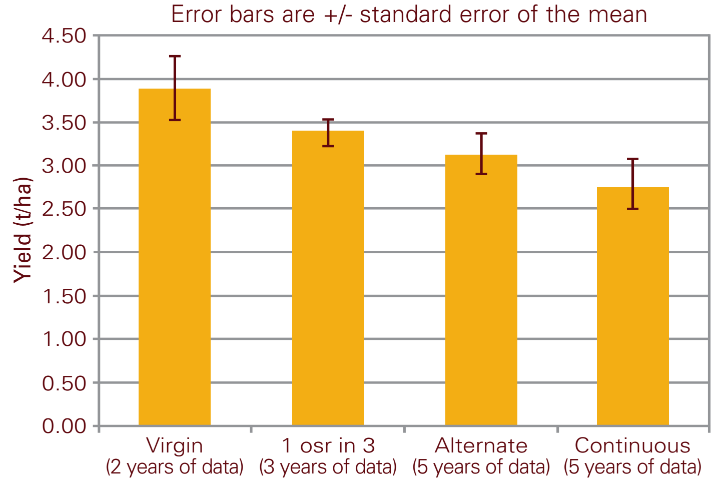
The project has shown:

– Clear yield penalties from close rotations for both oilseed rape and winter wheat (with associated financial implications)

– A clear effect of rotational intensity on volunteer numbers, crop vigour and disease levels

Factors that may cause the yield reduction include increased soil-borne and foliar disease, more volunteer oilseed rape and reductions in rooting.

Figure 9. Rotational position and yield (t/ha).

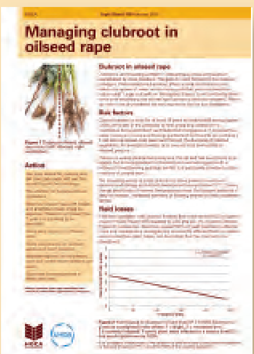


Soil-borne diseases

Planning rotations should take into account the farm's history of soil-borne diseases and the threat they pose to yield.

Clubroot

(*Plasmodiophora brassicae*)



– A threat to oilseed rape and other brassicas

– Risk is increased by short rotations, flooding, early sowing and warmer, wetter autumns and springs

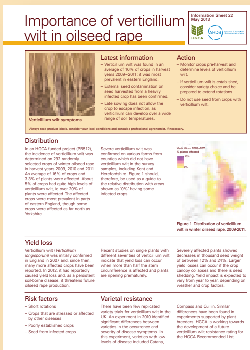
– Lengthening rotations remains the most sustainable long-term strategy on-farm

– Varietal resistance gives good control at most sites but is often poor at sites where resistant varieties have been commonly used previously

– Soil amendments that raise soil pH and calcium content can reduce disease severity

Verticillium wilt

(*Verticillium longisporum*)



– Affects oilseed rape and other brassicas

– Assessment of risk relies on examination of the previous crop

– A soil test may become available in the future

Sclerotinia stem rot

(*Sclerotinia sclerotiorum*)

– Affects oilseed rape and other crops such as potatoes, peas, carrots and many other vegetables

– Good fungicide protection is available

– It may be necessary to extend rotations at sites with severe epidemics

Weed seed production

To avoid an increase in the size of the weed seed bank in the soil, weeds must not be allowed to flower and shed viable seeds. Weed species that germinate early, usually just after establishment of the crop, produce the greatest number of seeds. Later-germinating weeds can be suppressed by the crop if it is vigorous with a large canopy.

Weeds are more likely to produce seeds in oilseed rape crops with small canopies over winter, especially where pigeon damage has occurred. The seed bank in the soil can be reduced by using a 'stale seed bed' technique. This involves cultivating then allowing a period of time for the weed seeds in the top 5 cm of soil to germinate before controlling the weeds using further cultivations or a herbicide.

For more information, see 'Managing weeds in arable rotations' and 'Encyclopaedia of arable weeds'. **www.hgca.com/weeds**

Table 1. Seed production and longevity of common weeds of oilseed rape.

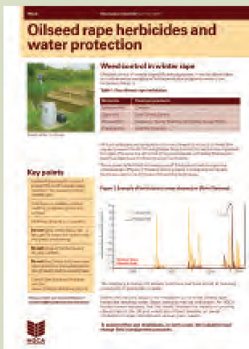
Common name	Scientific name	Max. seed production per plant	Seed longevity (years)
Black-grass	*Alopecurus myosuroides*	800	1-5
Charlock	*Sinapis arvensis*	16-25,000	>5
Cleavers	*Galium aparine*	300-400	1-5
Crane's-bill	*Geranium spp.*	1-9,500	1-5
Hedge mustard	*Sisymbrium officinale*	2,700	-
Italian rye-grass	*Lolium multiflorum*	800	1-5
Poppy	*Papaver rhoeas*	20,000	100
Prickly sow thistle	*Sonchus asper*	5,000	>5
Scentless mayweed	*Tripleurospermum inodorum*	10,000-20,000	>5
Shepherd's-purse	*Capsella bursa-pastoris*	2,000-40,000	>5
Volunteer oilseed rape	*Brassica napus*	8,000-10,000	>5
Wild radish	*Raphanus raphanistrum*	160	>5

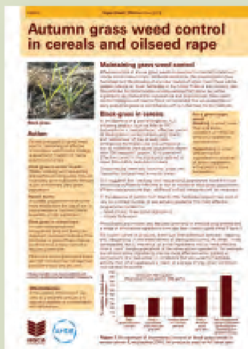
Herbicides and water protection

Including oilseed rape in the rotation allows the use of different herbicide modes of action to control black-grass. Black-grass does not show resistance to carbetamide and propyzamide and these active ingredients are an important part of a herbicide control programme.

Several of the key residual grass weed herbicides for use in oilseed rape are being found in water – metazachlor, carbetamide and propyzamide. Unless extreme care is taken to protect water from these herbicides, there is a serious risk that their use will be restricted.

For more information, see Information Sheet 09, Topic Sheet 116 and **www.voluntaryinitiative.org.uk**





Nutrient management planning

Nutrient requirements

Whether the crop's nutrient requirements are met depends on the quantity of nutrient available for plant uptake in the soil and in applied fertiliser, together with the capacity of the crop to take it up. It is also important to maintain the correct soil pH to maximise the availability of nutrients for plant uptake.

Soil and crop analyses should be used to determine fertiliser and liming requirements. Fields should be soil sampled every 3-5 years to determine the requirements for lime, phosphorus (P), potassium (K) and magnesium (Mg). All oilseed rape crops generally require nitrogen (N) and sulphur (S) fertiliser, for which the amounts required can be determined using look-up tables or measurements of the soil and crop. The crop requirements of some nutrients, such as sulphur, can also be estimated by tissue analysis of the growing crop.

Annual applications: N and S

Applied N usually gives the greatest yield response compared with other nutrient applications. Yield responses are typically in the range of 1 to 2.5 t/ha, depending primarily on the amount of mineral N in the soil that is available for plant uptake.

Most sites contain sufficient soil N to enable good crop establishment in autumn/winter. Autumn N applications:

– May be required where the supply of plant-available N in autumn is very low
– Should be applied to the seedbed at the time of sowing or as a dressing before mid-September
– Are less likely to benefit crops sown after early September

The maximum permitted autumn dose is 30 kg N/ha in a Nitrate Vulnerable Zone (NVZ).

The main N applications to oilseed rape should be in spring when the crop is growing rapidly, to ensure as much N as possible is used by the crop rather than being lost through leaching or volatilisation. Spring N applications:

– Should be planned between November and February following assessment of the Soil Nitrogen Supply (SNS)

See pages 24-25 and the Fertiliser Manual (RB209) for more information.

> To check whether your fields are in an NVZ and for guidance on fertiliser applications in an NVZ go to **www.gov.uk/nitrate-vulnerable-zones**

Sulphur has traditionally been applied to fewer crops than N but the requirement for S applications has increased as sulphur deposition has fallen by around 90% since 1980. The Fertiliser Manual (RB209) recommendations are that sulphur should be applied to all crops grown on mineral soils. HGCA Topic Sheet 66 suggests applying 75-100 kg SO_3/ha in spring. S products (eg ammonium sulphate) should be applied in early spring but slight or moderate deficiencies can be corrected by applying as late as yellow bud.

Oilseed rape is sensitive to sulphur deficiency and, even if deficiency is not severe enough to noticeably reduce yield, it may reduce oil content. Factors that increase the likelihood of deficiency include light-textured soils, calcareous soils, soils with low levels of organic matter and high rainfall which increases the risk of leaching.

Sulphur deficiency can be diagnosed by the presence of interveinal chlorosis (yellowing) of young or middle leaves, pale yellow flowers, or by analysing young fully expanded leaves during stem extension using a malate:sulphate test, which is carried out by several labs (Topic Sheet 66 contains more details). This test may be too late to apply remedial sulphur to the current crop but should also be used to guide the sulphur requirements of subsequent crops.

Long-term soil maintenance: P, K, Mg and pH

Phosphorus (P), potassium (K) and magnesium (Mg) are less mobile in the soil than N. Many soils contain large reserves of each, although only a small proportion may be available for the crop to take up. The Fertiliser Manual (RB209) recommends maintaining soil indices of 2 for phosphorus, 2- for potassium and 1 for magnesium, and gives guidelines on the applications necessary to achieve these depending on the nutrient indices of the soil, any manure applications and nutrient offtake by the crop. Applications are not necessary when soils are above the target indices.

Large yield responses should not be expected in the year in which these fertilisers are applied unless nutrient indices are very low. Soils should be tested every 3-5 years to ensure target indices are being achieved. Tests involve taking 25 soil cores (to around 15 cm soil depth), mixing and subsampling to get a representative sample.

> The optimum pH for soils under continuous arable cropping is 6.5. This will maximise the availability of most nutrients to plants. Soils naturally rich in calcium carbonate (lime) or magnesium carbonate have a pH of around 8. Soil pH should be measured regularly and acid soils should be treated with a liming material, such as ground limestone. Soil pH levels can be spatially variable, so where problems are suspected, multiple tests per field are required. Soil pH should be managed across the rotation as some crops – notably sugar beet and oilseed rape – are more susceptible to acidity than others. If lime is to be applied, it is beneficial to do so immediately before one of these more susceptible crops.

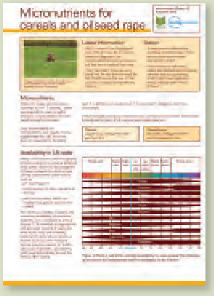
Micronutrients

Micronutrient deficiencies severe enough to cause large yield reductions are rare. HGCA research has shown that the most common micronutrient deficiencies limiting productivity of UK oilseed rape are boron (B), manganese (Mn) and molybdenum (Mo).

Diagnosing nutrient deficiencies

Several analytical labs test soil and plant tissue for micronutrients. A FACTS qualified adviser should be consulted to aid interpretation of lab results as thresholds indicating deficiency have not been firmly determined for all micronutrients and in many cases other factors must be considered, such as the crop's growing conditions. Table 2 describes deficiency symptoms and whether a soil or tissue test is more appropriate for deciding whether to apply nutrients.

For more information, see Information Sheet 25 **www.hgca.com/publications**


Micronutrients for cereals and oilseed rape

Boron deficiency: puckered leaves.

Manganese deficiency: yellowing/mottling between veins.

Table 2. Diagnosis of nutrient deficiencies in oilseed rape.

	Deficiency symptoms	Most appropriate lab test	Test details
Nitrogen (N)	Leaf yellowing, initially of older leaves, starting in early spring; plant stunting; reduced leaf number and pod size.	Soil	Plan annual applications using, if necessary, a measurement of Soil Mineral Nitrogen. See pages 24-25 and TS115 for more details.
Sulphur (S)	Diffuse yellowing of youngest leaves which may curl; pale flowers.	Tissue	If deficiency is suspected, use the malate:sulphate ratio test. For details see Topic Sheet 66.
Phosphorus (P)	Purpling of older leaves. Deficiency symptoms only evident on very deficient soils.	Soil	Target soil index: 2 (16-25 mg/l). Refer to the Fertiliser Manual (RB209) for recommended applications.
Potassium (K)	Yellowing/browning of leaf margins; necrosis of older leaves. Deficiency symptoms only evident on very deficient soils.	Soil	Target soil index: 2- (121-180 mg/l). Refer to the Fertiliser Manual (RB209) for recommended applications.
Magnesium (Mg)	Yellowing between veins on older leaves; brown or purple spreading in from leaf edge.	Soil	At Mg index 0 and 1 apply 50-100 kg MgO/ha every three or four years. Refer to the Fertiliser Manual (RB209) for more details.
Boron (B)	Young leaves are smaller and puckered, margins turn down and tissue becomes brittle and is easily torn; stem cracking and poor flowering.	Soil	Soil hot water extraction: less than 0.8 mg B/litre dry soil may indicate deficiency.
Manganese (Mn)	Yellowing/mottling between veins, which remain greener. Symptoms appear first on middle leaves, spreading to older leaves.	Tissue	Tissue Mn levels less than 20 mg/kg dry matter may indicate deficiency.
Molybdenum (Mo)	Reduced leaf area; pale and limp leaves.	Soil	Ammonium oxalate extract: deficiency is more likely below 0.1 mg Mo/litre.

Key diseases, pests and weeds

Diseases

Disease development is strongly influenced by rainfall, temperature and the carry over of disease from previous crops. Information is available to help identify the risks each season and on fungicide performance, see **www.hgca.com/diseasecontrol**

The most important foliar diseases of oilseed rape are **phoma leaf spot/stem canker** and **light leaf spot**. Forecasting tools are available for these diseases at **www.rothamsted.ac.uk/phoma-leaf-spot-forecast** and **www.rothamsted.ac.uk/light-leaf-spot-forecast**

Soil-borne diseases, **sclerotinia stem rot**, **clubroot** and **verticillium wilt**, have increased in recent years, favoured by shorter rotations.

Other soil-borne pathogens may be responsible for lower oilseed rape yields in tight rotations. Where yields are low and crops lack vigour in the autumn, longer rotations may be beneficial.

Phoma leaf spot/stem canker
(*Leptosphaeria maculans* and *L. biglobosa*)

- Often the most important disease in southern and eastern England
- Can affect crops from emergence onwards
- The fungus grows down the petiole and invades the stem to produce stem cankers that cause premature ripening and lodging
- Plants with large leaves are less vulnerable than small plants
- Managed at the leaf spot stage in autumn/winter using resistant varieties and fungicide sprays

Light leaf spot
(*Pyrenopeziza brassicae*)

- Historically, it was most serious in Scotland and the north of England
- Has increased in importance in recent years throughout England
- Risk can be predicted from disease levels on the pods of the previous year and summer temperatures
- Managed using resistant varieties and fungicide sprays
- Control may be affected by fungicide resistance but spray timing is more important

Sclerotinia stem rot
(*Sclerotinia sclerotiorum*)

- Often causes little damage but can halve yields when severe and poses a threat to other broad-leaved crops in the rotation
- Risk is dependent on the amount of spore production during flowering and the occurrence of suitable weather for petals to stick to the leaves
- Fungicides give very effective control but must be applied before infection takes place

Clubroot
(*Plasmodiophora brassicae*)

- Widespread in the UK
- Yield losses in affected crops can exceed 50%
- Lengthening rotations remains the most sustainable long-term strategy on-farm
- Use lime to maintain soil pH near 7

Verticillium wilt
(*Verticillium longisporum*)

- An emerging soil-borne problem that is now common
- Yet to have much impact on yield

Pests

Oilseed rape crops are at risk from invertebrate pests from establishment through to pod filling.

Slugs

Slugs can potentially kill plants even before they emerge and can also cause significant plant losses post-emergence.

Cabbage stem flea beetle

'Shot-holing' of the cotyledons and early leaves by adult cabbage stem flea beetle can reduce green leaf area. Subsequently, the larvae feed within the leaf petioles and stems, reducing crop vigour.

Peach–potato aphid

Peach–potato aphids (*Myzus persicae*) migrate into crops during autumn and may transmit turnip yellows virus.

In the spring, when stem extension begins, plants can be colonised by pollen beetle, seed weevil and pod midge.

Pollen beetle

Pollen beetle is most damaging when its migration coincides with the green/yellow bud stage, as feeding on the developing buds can reduce the number of pods that develop.

Seed weevil and brassica pod midge

Seed weevils lay eggs within the pods and the larvae feed on developing seeds. Exit holes in the pods created by seed weevil larvae returning to the soil to pupate provide access for pod midge adults to lay their eggs.

Feeding by pod midge larvae on the pod walls can result in premature pod splitting and the loss of all seed from the affected pod. Yield losses from pod midge are, therefore, potentially greater than direct losses from seed weevil.

Weeds

The most common weeds that infest oilseed rape mainly germinate in late summer and autumn, often with a further germination period in the spring. The greatest problems tend to occur with weeds that germinate at the time of crop emergence when the crop is small and uncompetitive. Knowledge of weed germination can help to select the most effective weed control measures (Table 3).

Table 3. Germination periods of the common weeds of oilseed rape.

[blank] = germination under 5% [light green] = germination 5-20% [dark green] = germination over 20%

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Black-grass			over 20%	over 20%	5-20%					5-20%		
Charlock	5-20%	5-20%	5-20%						5-20%	over 20%	over 20%	5-20%
Chickweed	5-20%	5-20%	5-20%	5-20%						5-20%	5-20%	5-20%
Cleavers				over 20%	5-20%	5-20%			5-20%	5-20%	5-20%	
Crane's-bill	5-20%	5-20%	5-20%	5-20%						5-20%	5-20%	5-20%
Mayweeds				over 20%	5-20%	5-20%			5-20%	5-20%	5-20%	
Poppy				over 20%	5-20%	5-20%			5-20%	5-20%	5-20%	
Shepherd's purse	5-20%	5-20%	5-20%	5-20%						5-20%	5-20%	5-20%
Sow thistle	5-20%	5-20%	5-20%	5-20%						5-20%	5-20%	5-20%
Volunteer cereals	5-20%	over 20%	over 20%	over 20%	over 20%	5-20%						
Wild radish			5-20%	5-20%					5-20%	over 20%	over 20%	5-20%

Establishment – cultivations a

Seed source

All hybrid varieties must be grown from certified seed and cannot be home-saved. Growers home-saving conventional (open-pollinated) varieties are legally obliged to pay a royalty to the plant breeder either on a per hectare basis or, if the seed is cleaned and dressed, on a per tonne basis.

Seed should not be home-saved from crops with sclerotinia or verticillium infection or if weed seeds have been harvested with the crop, as this will increase the chance of disease and weed problems. Seed samples with a low thousand seed weight should also be avoided (PR313) as establishment is reduced when small seeds are sown into suboptimal seed beds (eg cold soil, compacted soil, soil with surface crusting or deep sowing). Home-saved seed should be tested to ensure it has high germination and no seed-borne disease problems.

Seed treatments

Seed treatments may be applied to control early disease problems. Treated seed must always be fully covered with soil to reduce the risk of birds eating the seed. Fungicide treatments can reduce alternaria, early phoma spotting, damping off and downy mildew (Table 4).

On 1 December 2013, a restriction on the use of neonicotinoid-treated seed was adopted. It is, therefore, no longer permissible to plant oilseed rape seed treated with clothianidin, imidacloprid or thiamethoxam. For more information, see **www.hgca.com/neonics**

Table 4. Seed treatments for oilseed rape (information taken from product labels and **www.pesticides.gov.uk**).

✓= label recommendation for control or reduction of pathogen/pest

		Seed-borne diseases	Other diseases
Example Product	Active ingredients	Phoma	Damping off
Agrichem Hy-Pro Duet	prochloraz + thiram	✓	✓
Thiraflo/ Thyram Plus	thiram		✓

Sowing date

Winter oilseed rape is typically drilled between mid-August and mid-September in England and Wales, or from mid-August to early September in Scotland.

Sowing date trials have shown that high yields can be achieved from drilling any time between mid-August and mid-September. The chance of a significant yield reduction becomes more likely for crops drilled after mid-September. Plant establishment can be reduced by late sowing (mid-September or later), so it may be necessary to compensate by increasing seed rates.

Crops sown in mid-August will take about 10 days to emerge compared with 14 days for crops sown in the second half of September (based on average temperatures for England). This is because the period from sowing to 50% plant emergence takes an accumulated thermal duration (sum of average daily temperatures) of 160°C-days.

Spring oilseed rape can be sown from February to April. Spring crops require higher plant populations than winter crops, with at least 40 to 50 plants/m^2 required for both hybrid and open-pollinated varieties.

Establishment methods

The aim of cultivations should be to:

– Correct any compaction

– Maximise seed-soil contact

– Sow seed at 2-3 cm depth (maximum 5 cm)

– Retain soil moisture next to seeds to allow germination

– Manage weed populations

– Reduce slug risk as far as possible

– Bury any herbicide residues

The most suitable technique for a given site depends on soil type, soil conditions, prevailing weather and likely pressure from weeds and slugs. In dry conditions, seed should be sown as soon as possible after cultivations to minimise soil moisture loss. Consolidation (rolling) after sowing is recommended in the majority of situations to retain moisture, reduce slug risk by restricting movement through soil and allow optimal performance of soil-applied herbicides, although it is important to avoid compaction due to excessive rolling.

Table 5. Summary of establishment techniques. *Cost relative to ploughing taken from HGCA Information Sheet 10			
Technique	Cost relative to ploughing*	Advantages	Disadvantages
Broadcast into standing crop/ stubble ('Autocast')	20-30%	Quick and cheap Can be done when ground is too wet to allow deep cultivations Low soil moisture loss Long stubble deters pigeons	Cannot use treated seed or pre-emergence herbicides as seed not covered Uneven trash distribution can cause uneven establishment Higher risk of slugs and volunteer cereals
Direct drill and roll	30-40%	Low soil moisture loss Long stubble deters pigeons	Uneven trash distribution can cause uneven establishment Higher risk of slugs and volunteer cereals
Sub-cast (eg drill with subsoiler, roll)	60-70%	Reduces soil compaction Low soil moisture loss Can deal with large amounts of trash	Uneven sowing depth in some systems May not be as effective in wet soil Weeds can germinate below herbicide layer
Non-inversion tillage (eg disc, combi-drill, roll)	70-80%	Flexible technique, suitable for most soils and conditions Reduces surface compaction	May lead to greater soil moisture loss
Ploughing systems (eg plough, combi-drill, roll)	100%	Can help control weeds, eg grass weeds Reduces cereal volunteers Reduces slug risk Reduces compaction and can improve rooting	High soil moisture loss possible Slow and expensive

Seed rate

Optimal canopies and resulting high yields can be achieved from a wide range of plant populations. However, dense plant populations are more likely to develop over-large canopies and have an increased risk of lodging in spring. **In ideal situations, the optimal plant population to maximise yield has been shown to be 25-35 plants/m² for both hybrid and conventional open-pollinated varieties** (Figure 10). A greater plant population may be required in situations of severe spring drought (as encountered in 2011). In these situations, open-pollinated varieties require slightly greater plant populations than hybrid varieties. Greater plant populations may also need to be established where the risk of pigeon grazing or weed competition is high. Crops with low plant populations compensate mainly by producing more branches from lower down the stem.

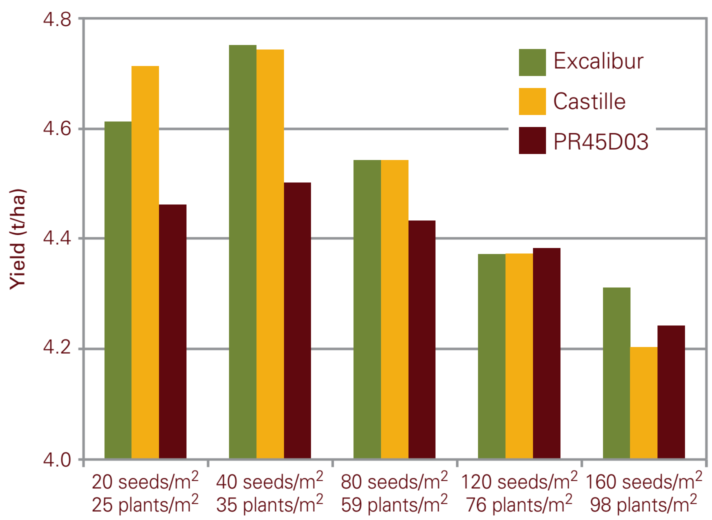
The seed rate necessary to achieve this target population will depend on the percentage plant establishment and the number of volunteer oilseed rape plants. Percentage establishment of sown seed depends on establishment conditions and slug pressure but is not affected by seed rate. Establishment rates usually range from 50-80% but, with typical volunteer numbers of 5-20 plants/m², a target plant population of 25-35 plants/m² can generally be achieved from 30-40 seeds/m².

$$\text{Seed rate (kg/ha)} = \frac{\text{Thousand seed weight (g)} \times \text{target seeds/m}^2}{100}$$

Row width

Establishment of oilseed rape in wide rows (greater than 30 cm apart) is becoming increasingly common. Research has indicated that when seed rates above 60 seeds/m² are used with wide rows, there is often a high degree of plant crowding and competition within rows which may mean that the optimum plant population is lower than for crops sown with traditional row spacings (3652 and 3605).

Figure 10. Yield response to seed rate for open-pollinated variety Castille, hybrid variety Excalibur and semi-dwarf hybrid variety PR45D03.



Note: Plants/m² numbers include volunteers.

Establishment – weed manag

Weed management

Prior to drilling, stubbles should be allowed to green over and any emerged weeds sprayed off with a non-selective herbicide. Delaying drilling will allow more weeds to emerge but may need a variety that can be sown later.

The effectiveness of chemical weed control is usually significantly increased in oilseed rape crops with vigorous growth because they compete more strongly against the weeds. Many herbicides are most effective when applied before crop emergence so it is often necessary to select the most appropriate herbicide based on a prediction of which weed species will germinate. Control methods for some of the most important weeds for oilseed rape are described below.

Black-grass

- Good control can be achieved with a sequence of metazachlor applied pre-emergence and propyzamide and/or carbetamide applied post-emergence
- These herbicides work best when establishment is by shallow cultivations: propyzamide forms a layer in the top 5 cm of soil

Charlock and wild radish

- Current suite of herbicides does not provide reliable control
- Killed by winter frosts
- Future control from metazachlor + imazamox in Clearfield varieties and ethametsulfuron-methyl

Crane's-bill (dove's-foot and cut-leaved)

- Have become a problem in oilseed rape in recent years through increased herbicide selectivity in the rotation
- Control is difficult and relies on pre-em applications or a post-em application of bifenox (EAMU*), correct timing is important
- Recent herbicide development has targeted crane's-bill, including ethametsulfuron-methyl (an ALS herbicide)

Poppy

- Control options are limited to pre- and very early post-emergence applications of metazachlor, with or without quinmerac
- Better control is achieved with a split application targeted at an extended weed emergence period
- Currently, no reliable post-em options are available but a coded product GF-2540 was tested successfully in 2012

Cleavers

- Populations of 1-10 plants/m^2 reduce seed yields and can contaminate harvested seed
- Best controlled using a pre-emergence herbicide (see Table 6 for options)
- There is also a post-em option (pyridate EAMU) that can be used before stem extension if the crop is well-waxed

Volunteer cereals

- Usually present in oilseed rape grown after a cereal unless the field has been ploughed
- Can establish quickly in late-drilling situations or drier autumns due to large seeds
- Yield losses are exacerbated by a delay in sowing and by thin or less vigorous oilseed rape crops
- In general, when 20 volunteers/m^2 are present, they should be controlled using graminicides

*EAMU: Extension of Authorisation for Minor Uses (previously SOLA)

Table 6. Common broad-leaved weeds controlled in winter oilseed rape by currently available active ingredients (information taken from product labels). s = susceptible, ms = moderately susceptible, mr = moderately resistant, r = resistant, - = not on label

	Pre-emergence				Pre- or post-emergence								Post-emergence						
					pre-em	post em	pre-em	post em	pre-em	post em*	pre-em	post em							
Active Ingredients	napropamide	clomazone	clomazone + metazachlor	tri-allate (EAMU)	dimethenamid-p + metazachlor		dimethenamid-p + metazachlor + quinmerac		metazachlor		metazachlor + quinmerac		bifenox (EAMU)	pyridate (EAMU)	clopyralid	clopyralid + picloram	propyzamide	carbetamide	propyzamide + aminopyralid
Charlock	-	-	-	ms	-	-	-	-	mr	mr	-	-	-	-	-	-	r	ms	-
Chickweed, common	s	s	s	ms	s	s	s	s	s	s	s	s	-	-	-	-	s	s	s
Cleavers	-	s	s	ms	s	r	s	s	mr	mr	s	s	mr	s	-	ms	ms	s	mr
Crane's-bill	-	-	mr	-	s	s	s	s	mr	mr	mr	-	s	-	-	-	-	-	-
Mayweeds	s	-	s	ms	s	r	s	r	s	s	s	s	-	-	s	s	-	r	s
Poppy	-	ms	s	ms	s	r	s	r	ms	ms	s	s	ms	-	-	-	r	-	s
Shepherd's-purse	-	s	s	-	s	ms	s	ms	s	s	s	r	mr	-	-	-	r	-	-
Sow-thistles	-	-	-	-	-	-	-	-	-	-	s	s	-	-	s	s	s	-	-

*Metazachlor can be applied when the crop is post-emergence but is only effective before weeds emerge.

Table 7. Common grass weeds controlled in winter oilseed rape by currently available active ingredients (information taken from product labels). s = susceptible, ms = moderately susceptible, mr = moderately resistant, r = resistant, - = not on label

	Pre-emergence			Pre- or post-emergence				Post-emergence									
Active Ingredients	napropamide	clomazone + metazachlor	tri-allate (EAMU)	dimethenamid-p + metazachlor	dimethenamid-p + metazachlor + quinmerac	metazachlor	metazachlor + quinmerac	propyzamide	carbetamide	propaquizafop	fluazifop-P-butyl	cycloxydim	quizalofop-P-ethyl	quizalofop-P-tefuryl	tepraloxydim	propyzamide + aminopyralid	clethodim
Barley	-	-	-	-	-	-	-	s	s	s	s	s	s	s	s	s	s
Oat	-	-	s	-	-	-	-	s	s	s	s	s	s	s	s	s	s
Wheat	-	mr	-	-	-	-	-	s	s	s	s	s	s	s	s	s	s
Annual meadow-grass	-	s	s	-	-	s	s	s	s	mr	r	r	-	-	s	s	s
Rough meadow-grass	-	-	s	-	-	-	-	-	s	-	-	mr	-	-	-	-	-
Barren brome	-	-	s	-	-	ms	-	s	s	s	s	s	s	-	s	s	-
Black-grass	ms	s	s	mr	ms	s	s	s	s	increasing resistance						s	mr
Wild-oat	-	-	s	-	-	-	-	s	s	s	s	s	s	s	s	s	-
Italian rye-grass	-	-	-	-	-	-	-	s	s	ms	s	s	s	s	-	-	-
Perennial rye-grass	-	-	-	-	-	-	-	s	s	s	s	s	s	s	-	-	-

Please note (applicable to tables 6 and 7): Stage of weed growth may affect level of control.

Peach–potato aphid, vector of turnip yellows virus

The peach–potato aphid, *Myzus persicae*, is the main vector of turnip yellows virus (TuYV). Annual sampling has shown that up to 72% of winged forms carry TuYV.

Turnip yellows virus is the most important viral disease of oilseed rape in the UK and can decrease yields by up to 30%. The virus is present throughout the UK but its prevalence is variable from year to year.

Pymetrozine can be applied once in the autumn and provides protection for approximately two weeks. Application timing is crucial and HGCA's Aphid News helps identify when to spray.

MACE resistance to pirimicarb and super kdr resistance to pyrethroids are common and widespread in *M. persicae* in the UK. There is no evidence of significant resistance (that may compromise control) to pymetrozine in the UK.

Early symptoms of TuYV are intense purpling of leaves; later symptoms (interveinal yellowing and reddening of leaf margins) are not usually expressed before stem extension and can easily be confused with other stress symptoms and nutritional deficiencies.

HGCA Aphid News provides information on aphid migration and the potential for virus spread throughout the crop. **www.hgca.com/pests**

Slugs

Germinating oilseed rape is highly vulnerable to feeding by slugs, particularly the grey field slug (*Deroceras reticulatum*). Plants are believed to be at risk up to the four-true-leaf stage.

The need for molluscicide application can be determined by trapping either in cereal stubble or, if this is impractical, in standing cereal crops.

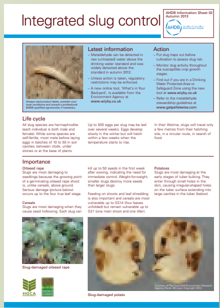
Monitoring slug numbers:

- Monitoring is most effective when soil is moist and temperatures range from 5-25°C
- Nine traps should be set in each field (13 if the field is larger than 20 ha) arranged in a 'W' shape
- Traps should be about 25 cm across and baited with two heaped teaspoonfuls of chicken layers mash placed under the trap – do not put slug pellets in the trap
- Leave traps overnight and examine in the morning
- Possible risk is indicated by four or more slugs per trap in standing cereals or one or more slugs per trap in cereal stubble

If slug pellets are required, they are best applied just after drilling. Applications to stubble are less effective than after drilling in wet autumns and may be unnecessary in dry autumns. Active ingredients include metaldehyde, methiocarb* and ferric phosphate.

Cultural control will also help to combat slugs. Cultivations after harvest to incorporate crop residues will reduce slug numbers, particularly in dry conditions. Drilling into a fine consolidated seedbed will help prevent slugs reaching seedlings before they emerge.

For more information, see AHDB Information Sheet 02 and visit **www.ahdb.org.uk/slugcontrol**


Integrated slug control

Water protection

Users of metaldehyde slug pellets should adhere to best practice guidelines to minimise contamination of water courses and help achieve compliance with drinking water standards.

Get Pelletwise!

Further details are available at **www.getpelletwise.co.uk**

Find out if you are in a Drinking Water Protected Area (DrWPA) or Safeguard Zone by entering your postcode into the Environment Agency's online tool 'What's in your Backyard' at **www.wiyby.co.uk**

* The approval for methiocarb-based slug pellets is being withdrawn.

Cabbage stem flea beetle

This pest is now found throughout most of England, Wales and southern Scotland. Beetles migrate into crops soon after emergence and bite 'shot-holes' in the cotyledons or early true leaves. The beetles lay eggs in the soil and, once they have hatched, the larvae bore into the leaf petioles and, later, into the main stems. If rain gets into the bore holes and freezes, it can cause winter kill.

Assessing the need to spray adult beetles

An assessment of the loss of leaf area due to shot-holing can be used to determine the need for a pyrethroid spray against adult cabbage stem flea beetle.

Consider applying a spray if:

- Adults have eaten over 25% of leaf area at the 1–2 true leaf growth stage
- Adults have eaten over 50% of the leaf area at the 3–4 true leaf stage
- The crop is growing more slowly than it is being destroyed.

Assessing the need to spray larvae

Water–trapping: Set four yellow water traps on the soil surface in early September: two on the headland and two in the field along a wheeling. Fill the traps with water and a drop of detergent to ensure that any insects caught sink and drown.

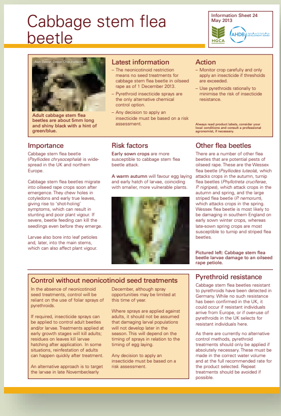
Visit the traps regularly, weekly if possible, and record the number of cabbage stem flea beetles, before emptying and resetting the traps. At the end of October, remove the traps.

A spray is justified if more than 35 beetles/trap have been caught in total over the monitoring period. This has been shown to be equivalent to the threshold of two larvae/plant. Do not spray if this threshold has not been reached.

Plant dissection: An alternative option to watertrapping, though more difficult, is plant dissection. A random sample of 25 plants should be taken from the field in late October/early November. Dissect all leaf petioles and stems with a sharp scalpel and count the number of larvae recovered. Samples are best dissected by an accredited laboratory.

A spray is justified if there are more than two larvae/plant or more than 50% of petioles are damaged.

For more information, see Information Sheet 24. **www.hgca.com/publications**


Cabbage stem flea beetle

Latest information

Action

Importance

Risk factors

Other flea beetles

Control without neonicotinoid seed treatments

Pyrethroid resistance

Leaf miners

Despite the unsightly mines, it is unlikely these pests will ever justify insecticide treatment. In general, it is only the first developing true leaves that are infested and these usually die during the winter.

The most obvious symptoms of attack are white/yellow blotch mines on the leaves, through which it is usually possible to see the leaf miner larva.

Leaf miner damage.

Rape winter stem weevil

Rape winter stem weevil adults lay their eggs on petioles close to the stem and larvae feed within the stems over winter. If severe, the crop can be stunted. There are no thresholds for this pest and it only appears to be a problem locally in certain parts of the country.

Cabbage root fly

Cabbage root fly is a potential pest of establishing rape but is generally only a problem in early-sown crops, particularly those that emerge in late August.

Damping off

Damping off is caused by various soil-borne fungi. They can kill seedlings before or soon after they emerge. Losses are usually small but seed treatments give some control (see page 16) and seed rates may be increased for later sowings to compensate for a higher risk of attacks.

Poor emergence and seedling collapse due to Rhizoctonia (right), controlled by seed treatment (left).

Phoma leaf spot

Phoma leaf spot (*Leptosphaeria maculans*) affects most crops but the onset of spotting is variable from year to year as this is determined by the rainfall from August onwards. Above average rainfall in August and September results in early epidemics (September/ October) and the greatest risk of yield loss (>0.5 t/ha).

Crops should be monitored at least weekly in autumn and a triazole fungicide spray applied when 10-20% of plants show phoma symptoms. A second spray is advised when reinfection occurs, usually 4-8 weeks later.

Fungicides are usually applied at half dose for phoma control and product choice is influenced by their growth regulatory activity. Where plants are small, prothioconazole is preferred but metconazole offers growth regulation and phoma control for crops with large plants.

There is a second type of phoma spotting, caused by a different species (*Leptosphaeria biglobosa*, previously known as Phoma B). It is also common but the lesions are small dark spots and more difficult to recognise than typical phoma symptoms.

This form of phoma is considered less damaging to yield and is controlled by the azole fungicides used for phoma and light leaf spot control.

Phoma leaf spot. A forecasting tool is available at **www.rothamsted.ac.uk/phoma-leaf-spot**

Powdery mildew

Powdery mildew (*Erysiphe cruciferarum*) is common in the autumn in some years. It is most obvious in early-sown crops but does not require specific treatment. It can be more severe later in the season (see page 27).

Powdery mildew.

Downy mildew

Downy mildew (*Peronospora parasitica*) is very common at the seedling stage as the cotyledons and first true leaves are more susceptible than later leaves. It can reduce plant vigour and heavily infected seedlings can be killed by frost. Seed treatment containing metalaxyl-M is effective (see page 16).

Downy mildew visible on the underside of a leaf.

Light leaf spot

Airborne spores produced on rape stubbles are dispersed into new oilseed rape crops in autumn. Light leaf spot (*Pyrenopeziza brassicae*) symptoms are uncommon until late autumn or early winter. The disease is most damaging in cold winters as it remains active when temperatures are too low for plant growth. Severely affected plants may be killed during the winter and surviving plants are stunted or distorted. Secondary spread of light leaf spot by splash-dispersed spores takes place throughout the year.

Where light leaf spot occurs regularly, an autumn fungicide is applied in November or early December. A second spray may be required in February or March if light leaf spot symptoms are found. Unlike phoma, light leaf spot is still a threat to yield in the spring and losses could be 30% if all plants are affected at early stem extension.

Only triazole fungicides are available for light leaf spot control. There are some concerns that their performance may be affected by fungicide resistance. Prothioconazole is the leading active ingredient but tebuconazole continues to perform well.

Light leaf spot. A forecasting tool is available at **www.rothamsted.ac.uk/light-leaf-spot**

Overwinter survival

In the absence of pressure from slugs and pigeons, plant losses from September drilled crops can be as much as 30%, mainly due to freezing conditions which can be exacerbated by waterlogging.

Start of spring growth to flow

Canopy management

Canopy management is a system of tailoring N rates and timings to optimise oilseed rape canopy size to maximise yield. The optimum green area index (GAI) at flowering is 3.5, with larger canopies having poor light use efficiency and a greater risk of lodging.

Spring nitrogen rate

$$\text{Nitrogen requirement (kg N/ha)} = \frac{\text{Target N (175 kg N/ha)} - \text{Soil Nitrogen Supply}}{\text{Fertiliser N recovery (0.6)}} + \text{Adjustment for higher yield potential}$$

Target N: Standard height or semi-dwarf oilseed rape must take up 50 kg N/ha to build each unit of GAI, so a crop with an optimum-sized canopy of GAI 3.5 at flowering contains 175 kg N/ha.

Soil Nitrogen Supply (SNS) can be estimated using either the Field Assessment Method (FAM) or by measuring Soil Mineral Nitrogen (SMN) – see Topic Sheet 115 for more information.

Fertiliser N recovery: Fertiliser N is taken up with an apparent efficiency of about 60%; Mineral N in the soil is taken up with around 100% efficiency. N already in the crop is assumed to remain in the crop.

Adjustment for higher yield potential: Crops with a yield potential in excess of 3.5 t/ha require additional N. Each 0.5 t/ha yield over 3.5 t/ha (up to a maximum of 5 t/ha) needs an additional 30 kg/ha fertiliser N.

Crop N

Crop N can be estimated by observation of the canopy size (GAI). Each GAI unit contains about 50 kg N/ha, or 40-50 kg N/ha for crops with a GAI of 2 or more. GAI can be assessed by comparing the crop to reference photos (see page 8), by uploading photos of the crop to **www.totaloilseedcare.co.uk**, or by cutting all the crop from 1 m^2 ground, measuring the fresh weight (in kg) and multiplying by 0.8. The latter method is most appropriate for crops with large GAIs of 3 or above.

Nitrogen timings

The majority of the fertiliser N required to reach a GAI of 3.5 at flowering should generally be applied between early green bud and yellow bud.

– Nitrogen fertiliser should be delayed for crops with large canopies of more than GAI 2 to reduce the chance of creating an over-large canopy and to reduce lodging risk.

– No single application should be greater than 100 kg N/ha.

Oilseed rape can take up about 3 kg N/ha per day until flowering (equating to a daily fertiliser use of 5 kg/ha after accounting for the 60% fertiliser uptake efficiency). Application timings must take this into account to allow sufficient time for most of the fertiliser N to be taken up by the middle of flowering, particularly where the recommended rate is high.

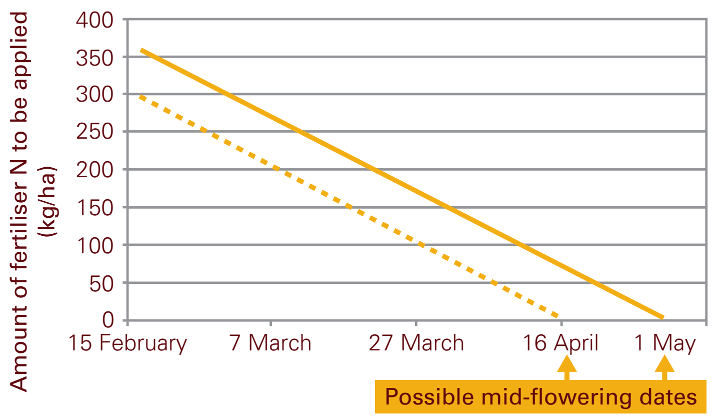
– The latest date for starting applications depends on the total N to be applied and the predicted date of mid-flowering (Figure 11).

Additional N for crops with high yield potentials should be applied later, at yellow bud or early flowering, to minimise the risk of creating an over-large canopy. Care should be taken to ensure the crop is not too tall to allow even application, particularly if using a spinning disc fertiliser spreader on wide tramlines.

If there is thought to be a risk of an unusually dry spring, a greater proportion of the nitrogen should be applied at the first split timing, to enable uptake before the soil becomes too dry.

For N applications to spring oilseed rape, follow RB209 recommendations. All fertiliser N should be applied in the seedbed around drilling, except in light sandy soils where splits are required to reduce the risk of nitrate leaching.

Figure 11. Latest date for starting N applications, assuming a mid-flowering date of either 1 May or 16 April. When the middle of flowering is expected to occur on a different date, the latest date to start applying N must be adjusted accordingly.

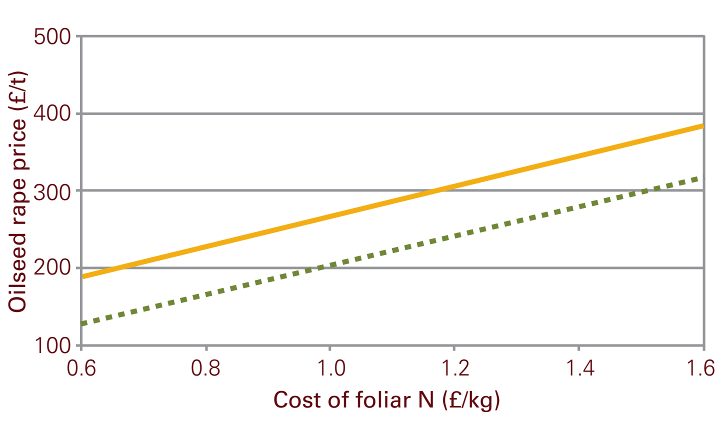


Foliar N

Application of 40 kg/ha foliar N at flowering, following the recommended rate of soil-applied N, has been shown to increase yield by around 0.25 t/ha but will also reduce seed oil content by an average of 0.9%, giving an equivalent seed yield increase of 0.2 t/ha. Recent HGCA trials across a range of site seasons (PR494) have concluded with the following:

- Foliar N rates should not exceed 40 kg N/ha
- Apply foliar N any time between mid-flowering and two weeks after the end of flowering
- Do not apply foliar N when the air temperature is above 18°C, to minimise scorch
- Foliar N should be cost-effective for the combination of oilseed rape and foliar N prices described in Figure 12.

Figure 12. Combinations of oilseed rape and foliar N prices required to give cost-effective foliar N applications, assuming 40 kg N/ha application gives 0.2 t/ha benefit. Relative costs must fall above the green dashed line assuming no additional application cost, or solid yellow line assuming £13/ha cost of application.



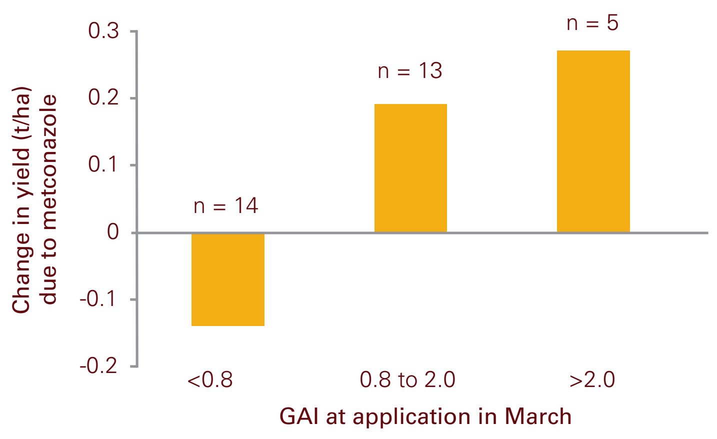
Plant growth regulators (PGRs)

PGRs usually increase yield in crops that have a GAI greater than 1 at early green bud (Figure 13) or greater than 2 at yellow bud. The yield increase is due to reduced lodging, increased seed set resulting from less light reflection from the flowers and (for metconazole) increased rooting below 40 cm depth.

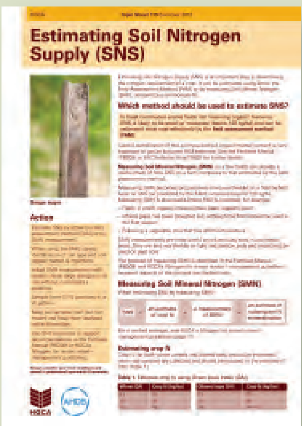
Yield responses are greatest when applications are made between late green bud and mid-flowering. Height reductions are greatest around late green bud to yellow bud, so it is often best to apply PGRs earlier to varieties with higher lodging risks.

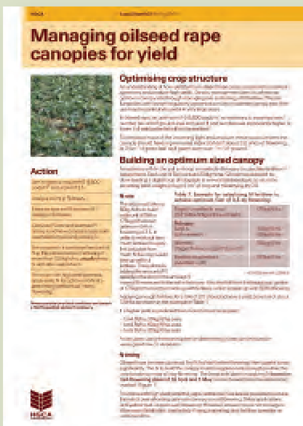
The most effective PGRs currently available for oilseed rape are metconazole and tebuconazole, both of which also have fungicide action. Given the timing window, PGR applications can also be aimed at controlling light leaf spot or sclerotinia. Where fungicides must be applied in spring to smaller crops that would not benefit from growth regulation, choose a product without PGR action.

Figure 13. Yield response to metconazole applied at full rate at green bud (March). n refers to the number of trials in which the response was measured.



For more information, see Topic Sheet 115 and Topic Sheet 103.
www.hgca.com/publications





Pollen beetle

Pollen beetles migrate to winter oilseed rape crops from mid-March and throughout April. If flowers are not open, beetles bite into and kill buds. Damage to buds declines as the flowers begin to open and pollen becomes more easily obtainable.

The damage-susceptible stage of the crop is green-yellow bud. Once the crop starts flowering, the beetles become pollinators rather than pests.

Crops are usually most at risk when the weather is dry and warm (above 15°C). Using baited monitoring traps (Oecos), as well as online pollen beetle migration forecasts, to detect local movement can allow efforts to be focused to when and where they are most needed.

The threshold for winter and spring oilseed rape is based on the maximum number of buds each beetle can destroy and the number of excess flowers produced by different crops. The plant population makes a large difference to the pollen beetle threshold, as plants in low plant population crops produce more branches and, therefore, more flowers.

Control thresholds for winter and spring oilseed rape:

- If there are fewer than 30 plants/m^2 the threshold is 25 pollen beetles per plant
- If there are 30–50 plants/m^2 the threshold is 18 pollen beetles per plant
- If there are 50–70 plants/m^2 the threshold is 11 pollen beetles per plant
- If there are more than 70 plants/m^2 the threshold is 7 pollen beetles per plant

Plants/m^2 can be estimated by counting the number of plants within a square foot and multiplying it by 11. Monitor the number of pollen beetles per plant by sampling at least ten plants along a transect of 30m (minimum) from the headland towards the centre of the crop throughout the damage-susceptible stage.

The UK Insecticide Resistance Action Group (IRAG-UK) has developed advice based on reducing use of pyrethroids and on exploiting other insecticide groups, which should be used cautiously to preserve their effectiveness.

Pollen beetle resistance to pyrethroid insecticides is now widespread throughout the UK. A strategy for contending with pyrethroid resistance needs to cover all spring and early summer insecticide applications, regardless of their intended target.

For more information, see Information Sheet 18.
www.hgca.com/pests

Bees

Bees are important pollinators. Pesticides vary in their toxicity to bees but those that present a special hazard carry a specific warning in the precautions section of the label.

Always read the product label.

Avoid unnecessary sprays.

Where possible, spray late in the evening, early morning or on a cool cloudy day, when bees are less likely to be flying.

Cabbage seed weevil and brassica pod midge

This small slate-grey weevil lays its eggs into developing oilseed rape pods during flowering. A single white larva with a brown head capsule develops inside the pod and feeds on the seed. Insecticide treatments are recommended during flowering and before petal fall if a threshold of one weevil per two plants is exceeded in northern Britain and one weevil per plant elsewhere.

The life cycle of the seed weevil is closely linked with that of the brassica pod midge. When the weevil larva exits the pod it creates a small hole through which the midge is able to lay its eggs. Numerous white larvae develop and feed on the pod walls which can result in their splitting and loss of the seed. Damage can be very conspicuous particularly on the headlands and, for this reason, its impact on yield can often be overestimated. Yield losses from pod midge are usually more than the direct yield losses from seed weevil.

Brassica pod midge larvae and symptoms.

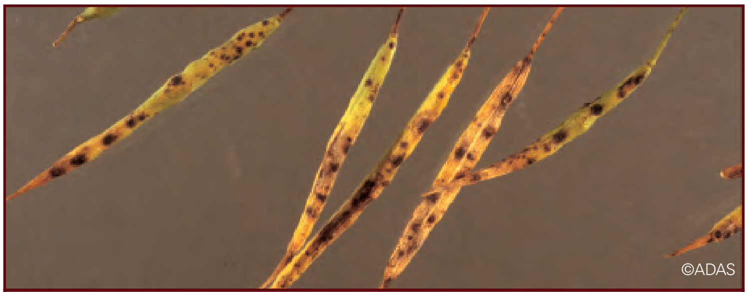
Sclerotinia

Sclerotinia stem rot (*Sclerotinia sclerotiorum*) is usually the main disease to consider at flowering. Crops in the UK are affected less severely than those in some parts of Europe. There were epidemics in 2007 and 2008 and localised problems occur in most years. Affected plants may suffer up to a 50% yield loss.

The infection cycle is complex. Fungal resting bodies (sclerotia) in soil germinate in spring when soils are moist and >10°C to produce pale brown fruiting bodies (apothecia) that release airborne ascospores. These spores land on oilseed petals and other plant surfaces and require external nutrients derived from petals and pollen to enable them to infect the plant. Plant infection requires long periods of high humidity and temperatures above 7°C and usually occurs when infected petals stick to the leaves or leaf axils. Sclerotinia spreads from leaf lesions to the stem and stem lesions increase in size girdling the stem to cause premature ripening and weakening stems so they lodge. New sclerotia are formed within the stem cavity and roots and are returned to soil at harvest.

Fungicides can provide very effective control of sclerotinia but they must be used as protectants. The optimum timing is usually just before mid-flowering. Treatments provide good protection for about three weeks. Where there is a high risk of sclerotinia, a two-spray programme may be used: the first spray at yellow bud to early flowering and the second three weeks later. Products with growth regulatory activity may be appropriate on crops with large canopies.

Sclerotinia stem lesion.



Alternaria pod spot.

Alternaria

Dark leaf and pod spot (*Alternaria* spp.) occasionally affects the stems and pods from flowering onwards. Severe pod attacks cause pod splitting and large yield losses. These are most likely to occur in southern regions where crops are lodged. Most fungicides used to control phoma, light leaf spot and sclerotinia have activity against dark pod spot. Specific treatment should be used if pods become affected during or soon after flowering.

Powdery mildew covering stems and leaves in early summer.

Powdery mildew

Powdery mildew (*Erysiphe cruciferarum*) usually develops late in the season but can quickly colonise stems and pods. It is often severe in spring oilseed rape, though its effects on yield have not been measured. Treatments applied for sclerotinia control, particularly triazole products, should have some activity against powdery mildew.

Grey mould on stem.

Grey mould

Grey mould (*Botrytis cinerea*) is a common but usually minor disease of leaves, stems and pods in oilseed rape. It is often associated with nitrogen fertiliser scorch or damage from frost or pests. Warm and wet conditions at flowering favour the disease, resulting in greyish leaf spots developing from fallen petals. Treatments for sclerotinia should provide some control.

Harvest and storage

Harvest options

Oilseed rape is not always an easy crop to harvest because its indeterminate growth patterns often result in uneven ripening between the early and late-formed branches.

There are three main harvesting techniques to choose from:

– Desiccation

– Swathing

– Direct combining

The best method depends on a range of factors, including location, stage of ripening, lodging, weed levels, weather and disease levels.

Timing

Seed filling lasts for approximately 40 days and it is important not to desiccate or swath too early since each day of seed filling lost will reduce yield by 1-2%. Seeds accumulate most oil during the second half of seed filling, so desiccating or swathing too early will also reduce oil content.

Harvest intervals vary, always read the label.

Yield losses

Yield losses due to travelling through the crop to apply a desiccant using a high clearance sprayer have been estimated at 0.6%.

Desiccation with glyphosate

– Cannot be used on a seed crop

– Use when grain seed moisture is 30% or less

– Translocation ensures complete desiccation

– Perennial weeds are controlled

– Rainfast on crop in four hours

– Poor results if stems are broken or kinked, crops are heavily diseased or in very uneven, weedy crops

– Can cause damage to seed potato crops

Desiccation with diquat

– Suits uneven crops after spring drought or pigeon damage

– Suitable where there are infestations of fleshy annual weeds, eg fat hen, orache, sow-thistle

– Contact action depends on good coverage

– Pods become brittle and shedding is a risk where harvest is delayed

– Use when more than half of the seeds in the top third are green with a few early ripening seed brown/black, 90% of the seeds in the middle third are reddish brown/dark brown and all the seeds in the bottom third are dark brown/black

Swathing

– Suits exposed sites and upright or leaning crops

– Lodged or leaning short crops present problems

– Crops should be largely weed-free

– Stubble must be at least 20-30 cm to raise the crop off the ground

– Swath around 6 weeks after the end of flowering when the seeds in the top third are green and green/brown, those in the middle third are green/brown and those in the bottom third are dark brown/black

Direct combining

– Lowest cost

– Avoids wheeling damage

– Crops must be uniform and largely weed-free

– Can often delay harvest

– Seed moisture content is usually higher at harvest

Desiccation with glufosinolate ammonium

– Keeps pods leathery

– Very slow acting

– Use when most seeds in the middle third are red/brown

Persistent diseases

Check for stem diseases when inspecting crops close to harvest. The presence of dead plants almost certainly indicates that there are disease problems that need to be identified to inform future decisions on variety, rotation and agronomic inputs.

Verticillium wilt symptoms often appear very close to harvest. Look for the distinctive brown or grey stripes running from soil level into the branches. Where high levels of verticillium wilt are found, it may be necessary to use a more resistant variety or extend rotations.

Sclerotinia causes white lesions on stems with black sclerotia within the stem cavity. It may be necessary to extend rotations at sites with severe epidemics.

Post-harvest, plough or cultivate oilseed rape stubbles before new crops emerge to reduce the spread of airborne spores of phoma and light leaf spot.

Volunteer rape plants should also be destroyed as they are a source of downy mildew, powdery mildew and virus vectors.

Preventing oilseed rape becoming a weed

Seed losses in oilseed rape at harvest have been reported as averaging 3,575 seeds/m^2, with a range of 2,000 to 10,000 seeds/m^2. There is a rapid decline in viable seed numbers in the first few months after harvest (60%), following which seed numbers in the seedbank decline at around 20% per year with 95% loss of seeds after nine years.

Volunteer oilseed rape should not be a problem in cereal crops as good control can be achieved. There is likely to be contamination of following rape crops with volunteers, which could reduce yield potential in crops with higher-yielding varieties and could cause contamination problems if the volunteers are speciality varieties such as high erucic acid rape (HEAR). Volunteer oilseed rape may also mean that the optimum plant population is exceeded. If other broad-leaved crops, such as beans and sugar beet, are included in the rotation, there may be difficulties with the control of volunteer oilseed rape.

Fresh seeds falling from the plant are not dormant and will germinate immediately as long as moisture is available. Dormancy can be induced by placing seeds into darkness by cultivating stubbles immediately after harvest. Dry soil conditions and fluctuating temperatures also induce dormancy.

To minimise the chance of oilseed rape becoming a volunteer, avoid immediate cultivation after harvest. **Cultivations should be delayed for four weeks where soil conditions are dry and two weeks when soils are moist.** This will allow seed to germinate and the seedlings to be destroyed by subsequent cultivations.

Oilseed rape volunteers.

Quality

Sprouted grain causes cloudiness in oil and increases processing costs. Crushers do not usually accept more than 5% sprouted grains in a sample.

Immature seed is green inside and may be red on the outside, although seed coat colour is not a reliable indicator. The green colouration is due to chlorophyll, which can cause heating in storage and rapid oil deterioration. Chlorophyll content can also be increased by sulphur deficiency.

Storage

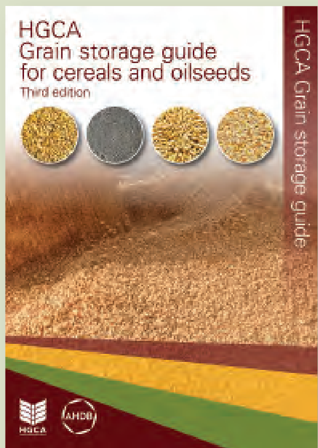
Safe, effective storage is key to ensuring crop quality. HGCA's Grain storage guide provides information on best practice in grain storage for cereals and oilseeds and is a key reference guide for most assurance schemes.

Cereals and oilseeds have different recommendations for the target moisture content. Oilseeds should be dried to 7.5-8% moisture content as soon as possible. Rapeseed becomes very brittle at low moisture contents so over-drying can be a problem. Free fatty acid content increases rapidly in broken seed and may cause oil degradation after crushing. Ventilating stores reduces the risk of increased free fatty acids because it helps reduce the build-up of heat, which is thought to contribute to their formation.

There is little leeway between the safest moisture content for prolonged, stable storage (7.5-8%) and the lowest acceptable moisture content (6%). Good practice, therefore, requires careful drying and accurate moisture meter calibration.

Rapeseed should be cooled rapidly to maintain oil quality and minimise the threat from moulds and mites. Oilseed rape has a much higher resistance to airflow than cereals. If using an aeration system designed for conventional cereals storage it is necessary to reduce the grain bed depth by 50-70% for storing oilseed rape.

For more information, see HGCA Grain storage guide for cereals and oilseeds.
www.hgca.com/grainstorage



Further information

HGCA publications and details of HGCA-funded projects are all available on the HGCA website – **www.hgca.com**

Market information and varieties

Email **subscriptions@hgca.ahdb.org.uk** or phone **024 7647 8730** to sign up for HGCA market information

HGCA Recommended Lists for cereals and oilseeds, HGCA (annual)

OSC2013 HGCA Oilseed Sellers' Checklist (2013)

Establishment

IS14 **No-till: opportunities and challenges for cereal and oilseed growers** (2012)

IS20 **Soil conditions and oilseed rape establishment** (2009)

Crop nutrition and canopy management

IS25 **Micronutrients for cereals and oilseed rape** (2013)

TS115 **Estimating Soil Nitrogen Supply (SNS)** (2012)

AHDB-IS01 **Improved analysis of solid manures and slurries** (2011)

TS103 **Managing oilseed rape canopies for yield** (2009)

TS93 **Improving oil content and minimising green seeds in oilseed rape** (2006)

TS66 **Diagnosing and correct S deficiency in wheat and rape** (2003)

Weed management

TS116 **Autumn grass weed control in cereals and oilseed rape** (2012)

G50 **Managing weeds in arable rotations – a guide** (2010)

IS03 **Herbicide-resistant black-grass: managing risk with fewer options** (2008)

IS07 **Identification and control of brome grasses** (2009)

IS09 **Oilseed rape herbicides and water protection** (2009)

Disease management

IS23 **Fungicide performance in oilseed rape** (2013)

IS22 **Importance of verticillium wilt in oilseed rape** (2013)

TS110 **Managing clubroot in oilseed rape** (2011)

Pest management

IS24 **Cabbage stem flea beetle** (2013)

AHDB-IS02 **Integrated slug control** (2013)

IS18 **Monitoring and control of pollen beetle in oilseed rape** (2013)

IS16 **Controlling aphids and virus diseases in cereals and oilseed rape** (2012)

G14 **Pest management in cereals and oilseed rape – a guide** (2003)

Grain storage

G52 **HGCA grain storage guide for cereals and oilseeds – 3rd edition** (2011)

Growth guides for other crops

G49 **Cereal growth stages – a guide for crop treatments** (2009)

G39 **The wheat growth guide – 2nd edition** (2008)

G30 **The barley growth guide** (2006)

HGCA Research Reviews

RR77 Implications of the restriction on the neonicotinoids – imidacloprid, clothianidin and thiamethoxam on crop protection in oilseeds and cereals in the UK (2013)

RR72 Relevance of verticillium wilt (*Verticillium longisporum*) in winter oilseed rape in the UK (2009)

RR70 Pesticide availability for cereals and oilseeds following revision of Directive 91/414/EEC, effects of losses and new research priorities (2009)

RR69 Turnip yellows virus (syn Beet western yellows virus), an emerging threat to European oilseed rape production (2008)

RR68 Better estimation of soil nitrogen use efficiency by cereals and oilseed rape (2008)

HGCA Project Reports

PR519 Impact of Previous Cropping on Winter Oilseed Rape (2013)

PR514 Survey of current agronomic practices influencing free fatty acid content in oilseed rape during the 2011/12 season (2013)

PR512 Importance and management of verticillium wilt in winter oilseed rape (2013)

SR21 Integrated management of cyst nematodes in oilseed rape (2013)

PR509 New strategies to maintain autumn grass-weed control in cereals and oilseed rape (2013)

PR504 Development of an integrated pest management strategy for control of pollen beetle in winter oilseed rape (2013)

PR502 Desk study to evaluate contributory causes of the current 'yield plateau' in wheat and oilseed rape (2012)

PR495 Re-evaluating thresholds for pollen beetle in oilseed rape (2012)

PR487 Management of clubroot (*Plasmodiophora brassicae*) in winter oilseed rape (2012)

PR494 Optimum N rate and timing for semi-dwarf oilseed rape (2012)

PR481 Assessing the benefits of using foliar N on oilseed rape (2011)

PR479 Breeding oilseed rape with a lower requirement for nitrogen fertiliser (2011)

PR465 Novel resources for oilseed rape breeding – improving harvest index (NOVORB-HI) (2010)

PR454 BulkDryRape – Interactive computer-based tool (2009)

SR12 Potential improvement of canopy management in oilseed rape by exploiting advances in root to shoot signalling (2009)

PR449 New fungicides for oilseed rape: defining dose-response activity (2009)

PR447 'Canopy management' and late nitrogen applications to improve yield of oilseed rape (2009)

PR446 Components of resistance to diseases in winter oilseed rape cultivars (CORDISOR) (2008)

SR04 The effects of an altered glucosinolate profile on the invertebrates within a *Brassica napus* crop (2008)

SR03 Resistance to spread of stem canker from leaf to stem: differences between RL winter oilseed rape cultivars (2008)

SR01 Effects of spring timings and rates of application of triazole fungicides on plant growth regulatory activity and control of light leaf spot and phoma canker of oilseed rape (2008)

PR442 Growing high oleic low linolenic (HOLL) oilseed rape for specialised markets (2008)

PR433 Sclerotinia in oilseed rape, a review of the 2007 epidemic in England (2008)

PR428 Revised thresholds for cabbage stem flea beetle on oilseed rape (2008)

PR420 Understanding sclerotinia infection in oilseed rape to improve risk assessment and disease escape (2007)

PR402 Management of oilseed rape to balance root and canopy growth (2006)

Current HGCA-funded projects

216-0007 Optimising sulphur management to maximise oilseed rape and cereal yields and farm profitability

214-0005 Validation of an integrated pest management (IPM) strategy for pollen beetle to minimise the development of insecticide resistance

214-0001 Investigating altered azole sensitivity in field populations of the oilseed rape light leaf spot pathogen *Pyrenopeziza brassicae*

RD-2013-3814 Investigating components of the oilseed rape light leaf spot epidemic responsible for increased yield loss to the UK arable industry

RD-2012-3813 Expanding the knowledge base to increase the use of home grown rapeseed meal and DDGS in diets for pigs and poultry in the UK

RD-2012-3812 Home grown oilseed rape meal and oilseed rape products as protein sources for pigs and poultry

RD-2013-3811 Nutritional value of oilseed rape and its co-products for pig and poultry feed, potential improvements, and implications for plant breeders

RD-2012-3790 Soil-borne pathogens of oilseed rape: assessing their distribution and potential contribution to yield decline

RD-2007-3457 Fungicide performance in oilseed rape

RD-2008-3525 Brassicas – Further development of 'in-field' test for resting spores of clubroot control based on detection

RD-2009-3676 Improved resistance to decrease risk of severe phoma stem canker on oilseed rape

RD-2008-3516 Effect of Turnip Yellows Virus on oilseed rape yield

RD-2008-3498 Turnip Yellows Virus (TuYV) in oilseed rape

RD-2007-3356 Reducing the carbon footprint of the lubricants industry by the substitution of mineral oil with rapeseed oil

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