Oilseed rape growth guide

Contents

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*This guide uses the BBCH growth stage system (see page 17).

Introduction

Oilseed rape (*Brassica napus*) is a member of the widely cultivated Brassicaceae family. Grown mainly for its oil-rich seed, it is the third-largest source of vegetable oil in the world. Crushing seeds extracts the oil. Residue produced from the crush, called rapeseed meal, is often used in animal feed. Globally, oilseed rape is the second-largest source of protein meal.

The crop has become an important part of many arable rotations. It is a useful alternative to a cereal crop and often referred to as a 'break crop'. However, the area grown recently has been well below the record 0.76 million hectares planted in 2012.

For harvest 2019, AHDB Planting Survey data put the English oilseed rape area at a 16-year low. The reduction in total area is most likely due to agronomic challenges, often related to the loss of key pesticides, and relatively high variable costs. However, with a relatively favourable gross margin, compared with feed wheat, where oilseed rape can be grown well, it performs competitively in the rotation.

The main purpose of this guide is to describe the crop's key growth stages and outline the main components of yield. This information can provide a foundation for management.

This guide does not cover agronomy, but it does highlight AHDB management resources.

The yield plateau

Since the early 1980s, there has been relatively little increase in commercial oilseed rape yields. Referred to as the 'yield plateau', this stagnation in output does not reflect the pace set by new varieties. In AHDB Recommended Lists (RL) trials*, yields have increased by about 0.05 t/ha each year. This has resulted in an increasing gap between farm yields and potential yields (Figure 1).

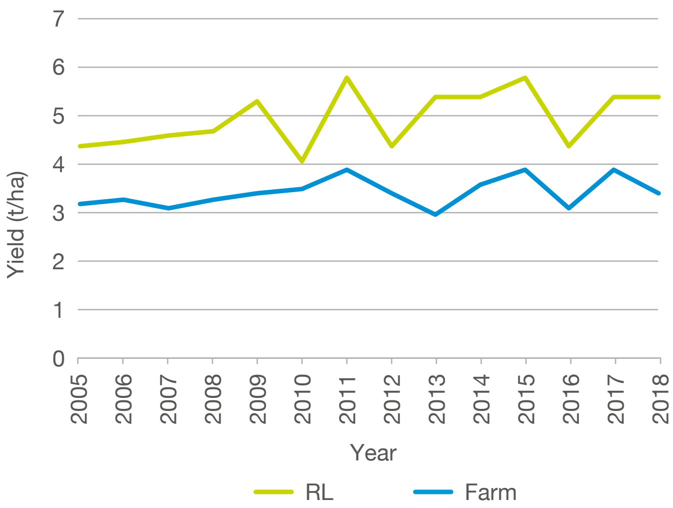


Figure 1. Oilseed rape yields for farm (blue line) and AHDB Recommended Lists trials (green line)

With potential UK yield estimated at more than 6.5 t/ha, research has looked to identify yield constraints in commercial situations.

In 2011, average farm yield was 0.8 t/ha above the long-term average of 3.1 t/ha. Analysis of crop-production data from this year found that the relatively high yields were mainly a result of good weather, rather than good management. The key factors in 2011 can be summarised as follows:

- Good weather after drilling that favoured consistent plant establishment
- A dry spring that restricted crop growth and promoted optimum canopy size
- A sunny spring that resulted in more seeds per pod and increased the rate of early seed fill
- A cool summer that prolonged the seed-filling period
- Favourable weather that limited disease and allowed good control with fungicides

In 2012, AHDB published an analysis of national yield trends and farm-specific data (from over the last 30 years). The research aimed to identify the agronomic factors, rather than the meteorological ones, that constrain oilseed rape yields. The work – AHDB Project Report 502 – found no single factor was responsible. However, it identified some major constraints:

- Increases in cropping frequency, leading to greater amounts of soilborne disease
- Poor selection and management of varieties
- Relatively low nitrogen- and sulphur-use efficiency

*Note: RL trials now have a greater emphasis on light leaf spot resistance than yield.

Principal growth stage (GS0–GS2)

GS0: Germination and emergence

For oilseed rape, the most critical growth stages span germination and emergence. The phase starts with 'dry' seed (GS00). Each seed contains two initial leaves, called cotyledons (oilseed rape is a dicotyledonous plant). The seed is small and its seedlings relatively weak. This makes the crop particularly susceptible to poor seedbed conditions (e.g. compacted soil), unfavourable weather (e.g. extended wet/dry periods), pests (e.g. slugs and cabbage stem flea beetles) and soilborne diseases (e.g. rhizoctonia and clubroot).

Normally, sowing occurs from about mid-August to mid-to-late September. The aim is to establish a target plant population of 25 to 40 plants/m^2, with seed rate adjusted to account for expected losses. Care to avoid excessive plant populations must be taken, as these are associated with reductions in yield.

Cotyledons start to emerge through the soil surface (GS09) from about five days after sowing.

Spring oilseed rape is sown from February to April with higher plant populations required (at least 40 to 50 plants/m^2).

GS1: Leaf development and GS2: Side-shoot formation

Once the cotyledons have unfolded (GS10), the leaf-development phase commences. GS11 occurs once the first true leaf unfolds. GS12 is once the second true leaf unfolds, and so on. The leaf-development phase is the longest and extends right through autumn and winter. Young leaves are often slightly hairy, whereas adult leaves are green and waxy. The upper leaves are also stalkless and clasp around the stem.

The crop grows indeterminately. This means that growth does not terminate with the formation of a reproductive structure. The crop produces multiple side shoots. The first detectable side shoot is GS21 and the second is GS22.

The growth habit of oilseed rape makes it relatively adaptable. In particular, the crop can compensate, to some degree, for low plant populations. It does this by producing more side shoots (branches) and, therefore, more flowers. The crop can also tolerate carefully timed mowing or grazing (e.g. as part of efforts to control cabbage stem flea beetle larvae) over the winter, as long as this occurs before stem extension.

Figure 2. Cabbage stem flea beetle damage on a recently emerged oilseed rape crop

Figure 3. An established crop of oilseed rape

Principal growth stage (GS3 and GS5–GS6)

Although these stages begin in chronological order, the phases often overlap. In fact, in the middle of spring, an oilseed rape crop may have open flowers, be developing flower buds and still be going through stem extension.

Note: GS4 does not apply to oilseed rape.

GS3: Stem elongation/extension

As temperatures warm in the spring, leaf development begins to end. At this time, stem elongation/extension and inflorescence/flower-bud emergence begins.

A node is the area where a leaf attaches to the stem. An internode is the gap between nodes. At the beginning of stem elongation, the crop has no internodes and is, therefore, short. This ‘rosette’ stage is GS30. As internode gaps increase, the crop gets taller. Once fully extended, oilseed rape stands at about 100–160 cm.

GS5: Inflorescence/flower-bud emergence

During stem elongation, inflorescence/flower-bud emergence occurs. At the ‘green bud’ stage (GS51), flower buds become visible from above the crop. At the ‘yellow bud’ stage (GS59), the first petals become visible within the closed bud.

GS6: Flowering

Flowers are borne on racemes (simple inflorescences that form on branch-like structures) from GS60. Flowers comprise four yellow petals in a cross form, alternating with four sepals. Flowers always open first at the lowest bud.

At GS65, the crop is in full flower. This is when 50% of the flowers on the main raceme are open. At this stage, older petals start to shed (petal fall).

The crop is open-pollinated. A wide variety of insect species, including bees, hoverflies and pollen beetles, contribute to pollination.

Figure 4. The first winter oilseed rape flowers

Canopy management

Crops harvest energy and convert natural resources into biomass (Figure 5). Leaves, which have a greater photosynthetic rate than pods and stems, play a critical role. Most solar-energy capture occurs in an open canopy, which allows light to penetrate down to the lower leaves.

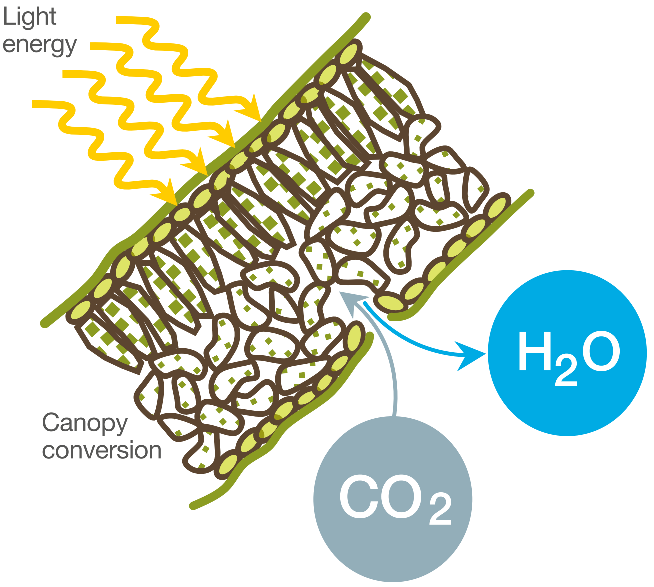


Figure 5. Crops harvest energy. They convert natural resources (solar energy, carbon dioxide and water) into edible and other forms of energy

The crop's green area index (GAI) can guide canopy management. GAI is the ratio of green leaf and stem area to the area of ground on which the crop is growing. Calculate GAI by:

- Comparing the crop to reference photos (Figure 6)
- Uploading crop photos to an online GAI tool
- Cutting all crop from a 1 m^2 area, measuring the fresh weight (in kg) and multiplying the weight by 0.8. This method is most appropriate where GAI is above 3

Nitrogen management has a significant effect on canopy development. The ***AHDB Nutrient management guide (RB209)*** provides information on nitrogen rates and timings.

If crops have a GAI greater than 1 at green bud (GS51) or 2 at yellow bud (GS59), then consider a plant growth regulator (PGR) application. A PGR will reduce lodging risk and increase seed set (as less light reflection is reflected from the flowers) and rooting below 40 cm. The optimal timing of a PGR application is between late green bud and mid-flowering, with earlier timing better for varieties associated with greater lodging risk. As several PGRs also have fungicidal activity, timing also needs to reflect the need to control diseases. Where canopy growth is suboptimal, consider fungicide products with no PGR activity.

The optimum GAI at flowering (GS60) is 3.5.

Figure 6. Winter oilseed rape at various stages of growth, with the associated green area index (GAI) value shown

Principal growth stage (GS7–GS8)

GS7: Pod/seed (fruit) development

Elongated green pods develop from pollinated oilseed rape flowers. GS71 occurs when 10% of pods have reached their final size. GS79 occurs when more than 90% of pods have reached their final size.

GS8: Pod/seed (fruit) ripening

Within each pod, a central inner wall creates two compartments. The seeds develop in a row within each compartment. Once seeds have expanded to fill the pod cavity, ripening (of pods and seeds) starts. At first, seeds are soft and green (GS80). Seeds then turn brown and, at maturity, become hard and black. The crop continues to ripen, while leaves and stems start to senesce. The crop is classed as fully ripe when nearly all (> 90%) pods are ripe/seeds are dark and hard (GS89).

Figure 7. Winter oilseed rape has elongated green pods

Seed number

Seed number is a critical yield component. At least 100,000 seeds/m² are required to achieve a yield of 5 t/ha (Figure 8). Photosynthesis during a 19–25-day period after mid-flowering determines seed set. Seed number is maximised by achieving an optimum pod number of 6,000 to 8,000 pods/m² (Figure 9). Crops with excessive pod numbers (e.g. >10,000 pods/m²) tend to have very thick canopies. Such crops have a lower rate of photosynthesis and this reduces seed set and the number of seeds per pod.

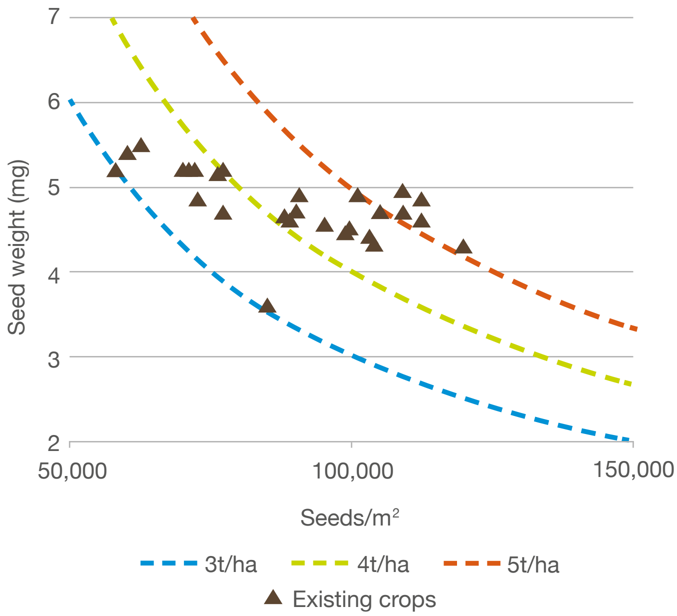


Figure 8. Seed number and seed weight observed for oilseed rape crops, and combinations of seed number and seed size required to achieve a yield of 3, 4 or 5 t/ha

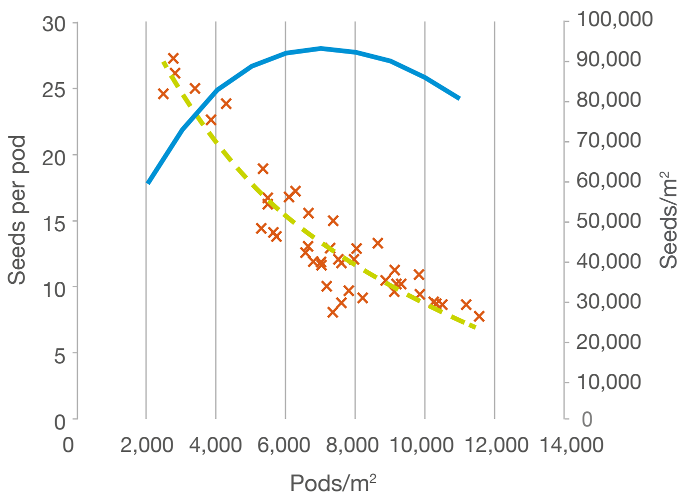


Figure 9. The effect of pod number on the number of seeds per pod and seeds/m²

Seed weight

For a crop to reach its full yield potential, each seed needs to fill completely. The rate of photosynthesis during the seed-filling period determines seed growth. Remobilisation of soluble carbohydrate (accumulated in the stem before flowering) also contributes to up to 10% of oilseed rape yield. Remobilisation is relatively low, compared with cereals (e.g. 20 to 50% in wheat).

Seed filling lasts for about 40 days. Most oil accumulates during the second half of seed filling (Figure 10). However, warmth (Figure 11), drought, disease or early desiccation all curtail the seed-filling period. Estimates suggest a yield reduction of 1–2% for each day of seed filling lost.

AHDB results show that 50% of oilseed rape crops may have insufficient roots below a depth of 40 cm to cope with dry conditions. In dry conditions, deep-rooted crops (i.e. beyond 1 m soil depth) are much more likely to have a significantly longer seed-filling period.

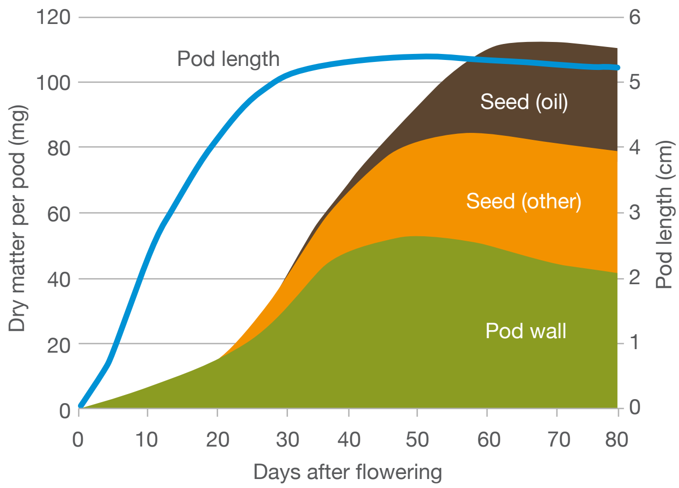


Figure 10. Pod length and typical biomass and oil accumulation in the pod wall and seed from flowering

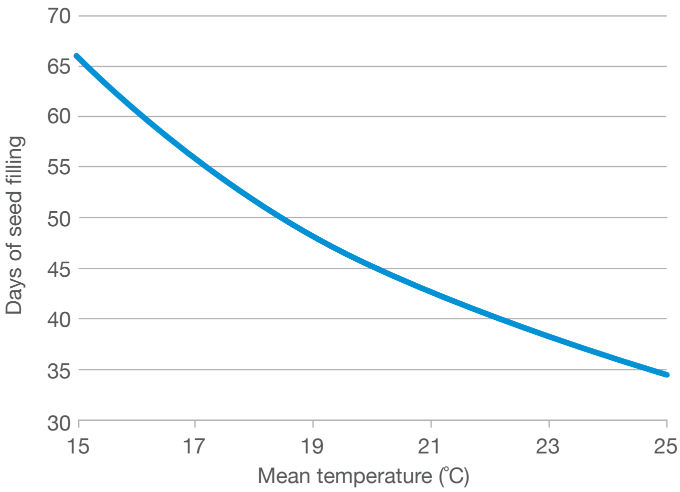


Figure 11. The effect of temperature on the duration of seed filling

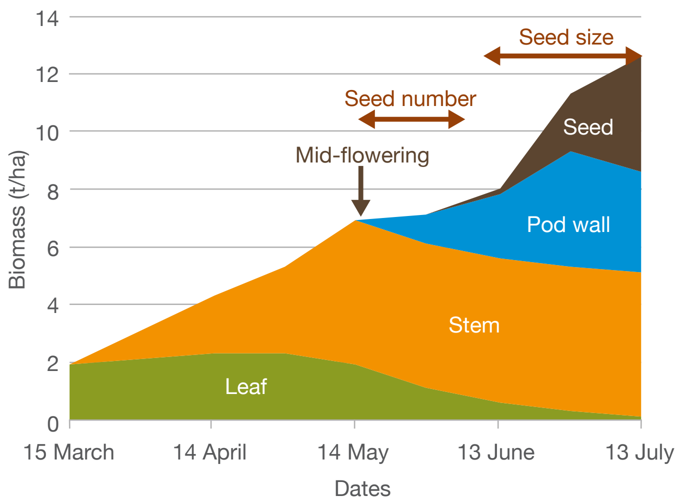


Figure 12. Biomass accumulation in a typical oilseed rape crop and key periods for determination of seed number and seed size

Principal growth stage (GS9) and harvest

GS9: Senescence

As pods and seeds ripen, senescence of the crop continues. By GS97, plants are completely dead and dry. By GS99, the crop is ready to harvest. At this stage, 35% of the crop's biomass is in the stem and 30% is in the pod wall. Even in semi-dwarf varieties, 33% of the biomass is in the stem. Most of the remaining dry matter (about 35%) is contained within the seeds. Seeds also contain about 50% of the crop's total energy content, with most of it stored within the energy-rich oil.

The indeterminate growth of oilseed rape can make the crop a challenge to harvest. Such growth results in uneven ripening between the early- and late-formed branches.

Three main harvesting techniques are available: desiccation, swathing and direct combining. The best method depends on a range of factors, including location, stage of ripening, lodging, weed levels, weather and disease levels. Timing is everything, as early desiccation or swathing reduces the seed-filling period.

Desiccation (with glyphosate)

- Do not use in crops grown for seed production
- Only apply when the seeds have less than 30% moisture content*
- Applied product is rainfast within four hours
- Complete desiccation occurs where translocation is unimpeded
- Up to 21 days may be necessary before combining (statutory harvest interval is 14 days)
- Spray drift can damage nearby seed potato crops
- Treatment of heavily laid crops, with major secondary growth or significant areas of uneven ripening (e.g. caused by pigeon damage or poor drainage), will not be as effective
- Expect poor results from laid crops, where stems have been broken (kinked stems are acceptable), and crops with heavy disease or weed burdens
- Can control actively growing perennial weeds
- Do not use treated straw as a horticultural growth medium or mulch

Access further information on desiccation with glyphosate at **ahdb.org.uk/glyphosate**

*Visual test for seed moisture content

Estimate 30% seed moisture content in three simple steps:

1. Select an area of the crop that is representative of the field as a whole. Then choose an area of canopy that is typical of the maturity of most of the crop. Depending on the canopy, this may be pods in the middle of the main raceme or on the side branches. At random, pick 20 pods from several plants.
2. Open each pod and observe how many seeds have changed from green to brown. If this change is observed in at least two-thirds† of the seeds per pod in at least 15 of the pods picked, then the earliest correct stage‡ for spraying has been reached. Spray the crop within four days, unless the weather is very cool (spray within seven days).
3. Check the assessment is representative of the entire field (repeat steps one and two, as required).

†If approximately half of the seeds are turning brown, then the earliest correct stage for spraying is likely to be in three days, but it is important to repeat the procedure to check that the crop is at the correct stage.

‡Spraying too early will result in poor desiccation. Confirm estimates with a moisture meter.

Swathing

- Swath around six weeks after the end of flowering. This is 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
- Suits exposed sites and upright or leaning crops, but not lodged or leaning short crops
- Crops should be largely weed-free
- Stubble must be at least 20–30 cm to raise the crop off the ground

Direct combining

- Lowest cost
- Avoids wheeling damage
- Crops must be uniform and largely weed-free
- Can delay harvest
- Seed moisture content is usually higher at harvest

Seed losses

Fully mature pods of oilseed rape are extremely sensitive to opening. When the crop is disturbed by wind or by machinery (e.g. desiccant application or the combine at harvest), some pods open and shed seeds – termed 'pod shatter'. Estimated losses, associated with a high-clearance sprayer, are 0.6%. Losses at harvest average 3,575 seeds/m^2, with a range of 2,000 to 10,000 seeds/m^2.

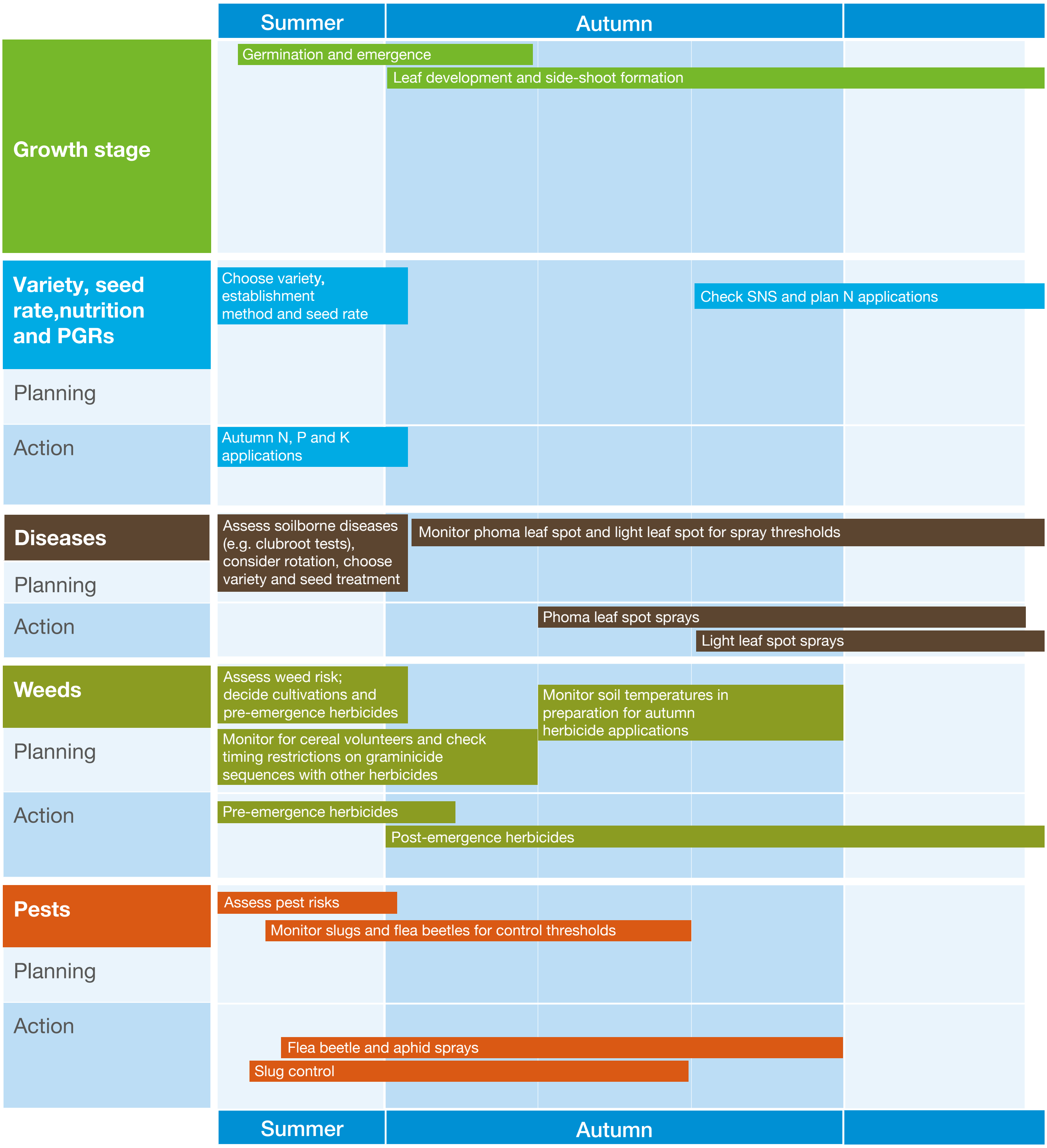
When seed germinates in a subsequent crop, it is called a 'volunteer' crop. In the first few months after harvest, there is a rapid decline in viable seed numbers (60%). Numbers in the seed bank decline at a rate of about 20% each year, with 95% loss of seeds after nine years.

Effective control of volunteer oilseed rape is achievable in cereal crops. However, they can cause issues in subsequent broad-leaved crops. In particular, if volunteers have elevated levels of erucic acid, they can potentially contaminate the main oilseed rape crop. For information on how to manage volunteers and associated erucic acid risks, visit **ahdb.org.uk/erucic-acid**

Gross output figures, published in the AHDB Recommended Lists (RL), are calculated from the seed yield, with an adjustment to take account of oil content. Seed yield is a component of the number of seeds harvested and the weight of each individual seed.

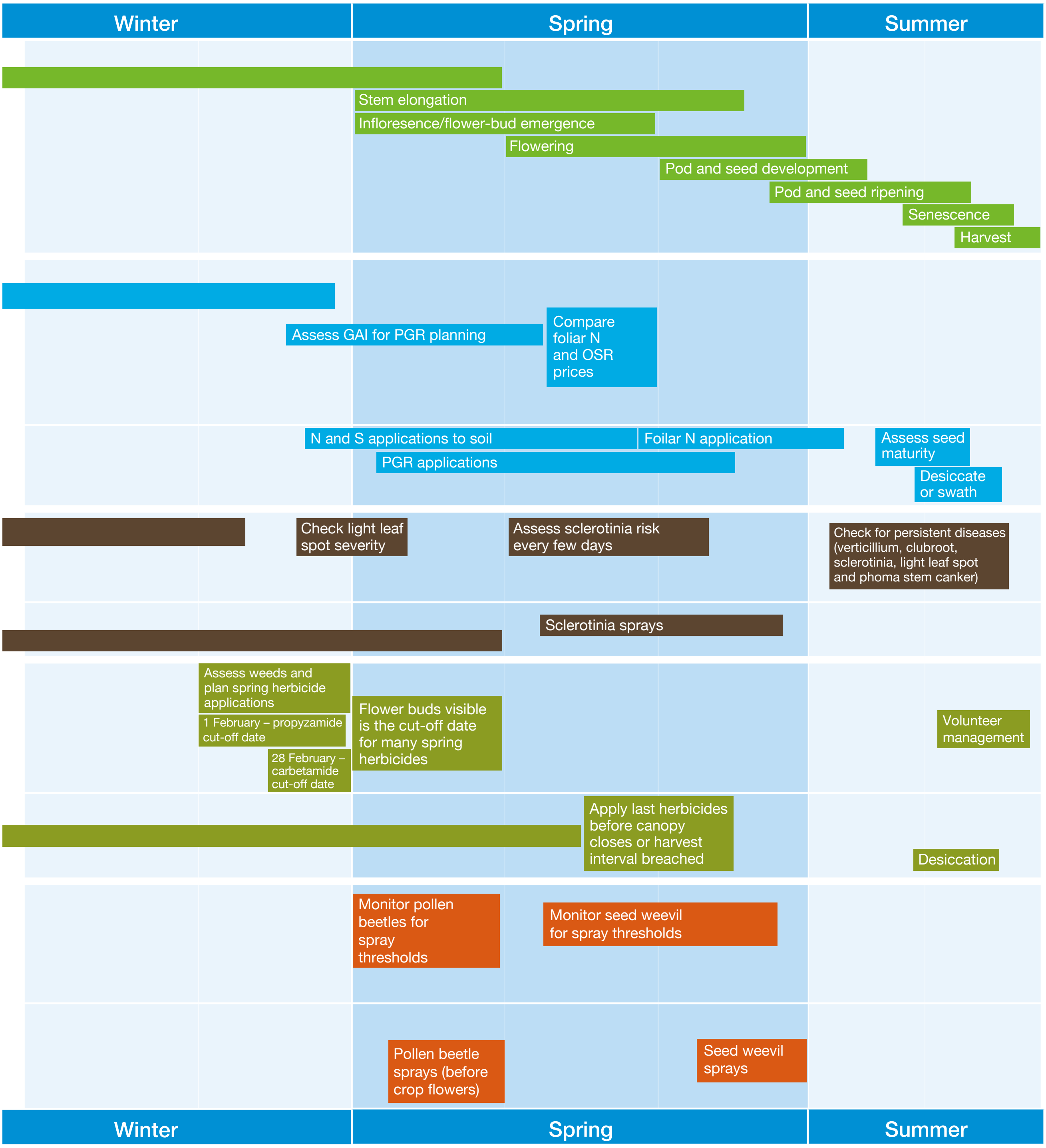
Figure 13. As oilseed rape matures, plant structures turn brown

Key management timings



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

Figure 14. Successful oilseed-rape-growing demands attention to detail – from before the crop is sown (e.g. variety and site selection), through every stage of the crop's growth cycle, to harvest and storage. The key periods and timings for the application of nutrients and plant protection products shown are indicative of what is typical for an oilseed rape crop. They are not recommendations. Consult advisers, who are BASIS-qualified (for plant protection products) or FACTS-qualified (for fertiliser products), for recommendations.



Winter
Spring
Summer
Stem elongation
Infloresence/flower-bud emergence
Flowering
Pod and seed development
Pod and seed ripening
Senescence
Harvest
Assess GAI for PGR planning
Compare foliar N and OSR prices
N and S applications to soil
Foilar N application
Assess seed maturity
PGR applications
Desiccate or swath
Check light leaf spot severity
Assess sclerotinia risk every few days
Check for persistent diseases (verticillium, clubroot, sclerotinia, light leaf spot and phoma stem canker)
Sclerotinia sprays
Assess weeds and plan spring herbicide applications
1 February – propyzamide cut-off date
28 February – carbetamide cut-off date
Flower buds visible is the cut-off date for many spring herbicides
Volunteer management
Apply last herbicides before canopy closes or harvest interval breached
Desiccation
Monitor pollen beetles for spray thresholds
Monitor seed weevil for spray thresholds
Pollen beetle sprays (before crop flowers)
Seed weevil sprays
Winter
Spring
Summer

Management resources

Recommended Lists (RL) for cereals and oilseeds

The RL provides information on yield and quality performance, agronomic features and market options to assist with variety selection. It 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 and resistance to phoma stem canker. The RL provides data for both conventional open-pollinated and restored hybrid varieties. The RL also includes a Descriptive List for spring oilseed rape that considers gross output, oil and glucosinolate content, standing ability, shortness of stem, earliness of flowering and earliness of maturity.

ahdb.org.uk/rl

GREATsoils

Oilseed rape can fall at the first hurdle. With relatively small seeds and weak seedlings, management needs to focus on providing the best environment to nurture the crop through its critical early growth stages. Once an oilseed rape plant has emerged and produced its first few leaves, it is more likely to grow well, produce flowers and pods and seeds. AHDB's GREATsoils resources can help with the management of seedbeds and the selection of the most appropriate sowing method.

ahdb.org.uk/greatsoils

Nutrient management guide (RB209)

To make the most of organic materials and balance the benefits of fertiliser use against the costs – both economic and environmental – follow RB209 guidance. Published across seven sections, the most relevant to oilseed rape production are: ***Principles of nutrient management and fertiliser use*** (section 1), ***Organic materials*** (section 2) and ***Arable crops*** (section 4). The Arable crops section covers the application of nitrogen, phosphate, potash, sulphur, magnesium and micronutrients. The guide also includes information on how to tailor nitrogen rates and timings to optimise canopy size.

ahdb.org.uk/rb209

Encyclopaedia of pests and natural enemies

Several pests of oilseed rape have become more of a challenge in recent years, due to the loss of pesticides and developing resistance issues. The ***AHDB Encyclopaedia of pests and natural enemies*** provides information on identification, risk factors, life cycles, monitoring, control thresholds, non-chemical control and insecticide resistance (where known) of major and minor pests. The publication covers brassica pod midge, cabbage seed weevil, cabbage stem flea beetle, cabbage root fly, peach–potato aphid (which transmits turnip yellows virus), pollen beetle, rape winter stem weevil and slugs.

ahdb.org.uk/pests

Oilseed rape disease management guidance

The management of the most important diseases of oilseed rape is the focus of this guidance. It covers soilborne diseases (e.g. clubroot, sclerotinia stem rot and verticillium stem stripe), many of which have increased in importance in recent years, favoured by shorter rotations. It also features the most important foliar diseases – phoma leaf spot/stem canker and light leaf spot.

ahdb.org.uk/osr-dmg

Managing weeds in arable rotations

Improved weed management through a rotation dominated by autumn-sown crops is the subject of this publication. The guide helps readers profile weed populations within the seed bank and build control based on a sound understanding of weed biology. The publication looks at the influence of crop choice, cultivation and drilling date. It also includes information on effective herbicide application to maximise control and minimise resistance risks and environmental impacts. It also provides information on how to minimise oilseed rape volunteer populations.

ahdb.org.uk/arableweeds

Harvest Toolkit

The AHDB Harvest Toolkit provides a wealth of information. It includes the latest harvest results (from RL trials), as well as links to grain quality, grain storage and grain marketing resources.

ahdb.org.uk/harvest-toolkit

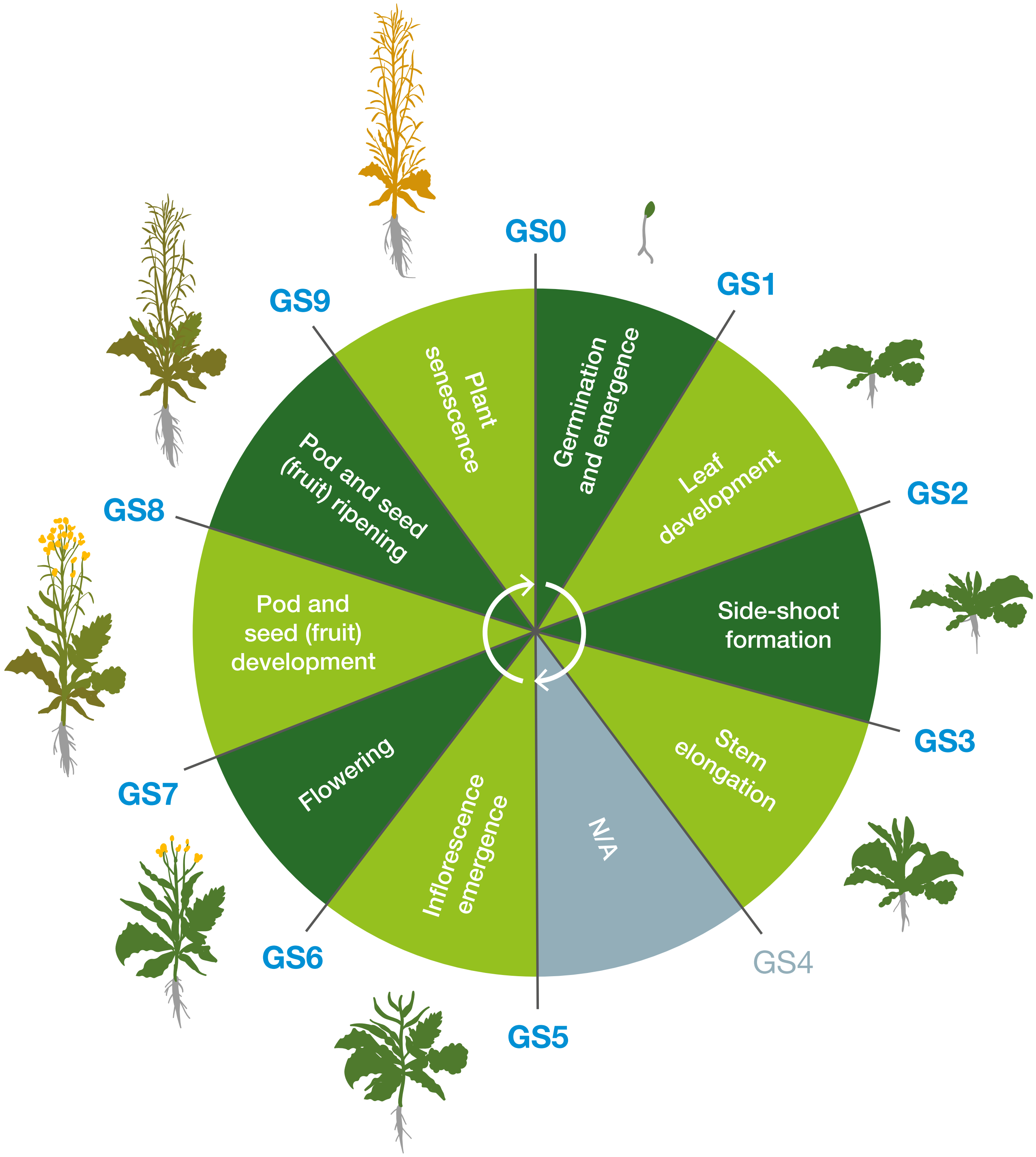
Growth stage keys

A plant's life cycle can be described by ten developmental phases. Understanding the principal growth stages (GS) can help assist with management decisions. For example, this uniform coding system, which is also used for cereals, features on plant protection product labels. This publication is based on the BBCH (**B**iologische **B**undesanstalt, **B**undessortenamt und **CH**emical Industry) scale. An alternative (AAB) system is also in use (page 18). Although there are striking similarities, there are also some key differences between them.

Growth stage systems: BBCH v AAB

When growth stages are cited, it is essential to know the system used.

Although the principal growth stages start in chronological order, the beginning of each stage is not dependent on the completion of the preceding stage. As a result, several stages overlap. Where overlaps occur, the guidance is to use the GS for the most advanced stage (e.g. the higher number). How quickly the crop moves through each stage depends on its environment and the variety.



Principal growth and secondary growth stage key (BBCH* system)

GS0: Germination and emergence

00	Seed dry
01	Seed imbibition starts
03	Seed imbibition complete
05	Radicle (embryonic root) emerged from seed
07	Cotyledons emerged from seed
09	Cotyledons emerged through soil surface

GS1: Leaf development

10	Cotyledons completely unfolded
11	First leaf unfolded
12	Second leaf unfolded
19	Nine or more leaves unfolded

GS2: Side-shoot formation

20	No side shoots
21	First side shoot detectable
22	Second side shoot detectable
29	Nine or more side shoots detectable

GS3: Stem elongation/extension

30	No internodes (rosette stage)
31	One visibly extended internode
32	Two visibly extended internodes
39	Nine or more visibly extended internodes

GS4: Does not apply to oilseed rape

GS5: Inflorescence/flower-bud emergence

50	Flower buds present and enclosed by leaves
51	Flower buds visible from above ('green bud' stage)
52	Flower buds free and level with the youngest leaves
53	Flower buds raised above the youngest leaves
55	Individual flower buds (main inflorescence) visible but closed
57	Individual flower buds (secondary inflorescences) visible but closed
59	Flower buds closed with first petals visible ('yellow bud' stage)

GS6: Flowering

60	First flowers open
61	10% of flowers on main raceme open
62	20% of flowers on main raceme open
65	50% flowers on main raceme open, older petals falling ('full flower' stage)
67	Flowering declining, most petals fallen
69	End of flowering

GS7: Pod/seed (fruit) development

71	10% of pods have reached final size
72	20% of pods have reached final size
79	≥90% of pods have reached final size

GS8: Pod/seed (fruit) ripening

80	Ripening starts (seeds green and filling pod cavity)
81	10% of pods ripe, with seeds dark and hard
82	20% of pods ripe, with seeds dark and hard
89	≥90% nearly all pods ripe, with seeds dark and hard

GS9: Senescence

90	Plant death starts
97	Plant dead and dry
99	Harvested product

*Adapted from 'Growth stages of mono- and dicotyledonous plants' (BBCH Monograph), 2001.

Principal growth and secondary growth stage key (AAB* system)

GS0: Germination and emergence

0.0 Dry seed

0.9 Cotyledons emerge through soil surface

GS1: Leaf production

1.0 Cotyledons unfolded

1.1 First true leaf

1.2 Second true leaf

1.6 Sixth true leaf

GS2: Stem extension

2.0 No internodes (rosette)

2.1 One internode

2.2 Two internodes

2.5 Five internodes

GS3: Flower-bud development

3.0 No flower buds present (only leaf buds present)

3.1 Flower buds enclosed by leaves

3.3 First flower buds visible from above ('green bud')

3.5 First flower buds raised above leaves

3.6 First flower stalks extending

3.7 First flower buds yellow ('yellow bud')

GS4: Flowering

4.0 First flower opened

4.1 10% of flower buds opened

4.2 20% of flower buds opened

4.5 50% of flower buds opened

GS5: Pod development

5.0 0% of potential pods

5.1 10% of potential pods

5.2 20% of potential pods

5.5 50% of potential pods

GS6: Seed development

6.0 No seeds expanding

6.1 Seeds expanding

6.2 Most seeds translucent but full size

6.3 Most seeds green

6.4 Most seeds green-brown mottled

6.5 Most seeds brown

6.6 Most seeds dark brown

6.7 Most seeds black but soft

6.8 Most seeds black and hard

6.9 All seeds black and hard

GS7: Leaf senescence

GS8: Stem senescence

8.0 All stem green

8.1 Most stem green

8.5 Half stem green

8.9 Little stem green

GS9: Pod senescence

9.0 All pods green

9.1 Most pods green

9.5 Half pods green

9.9 Few pods green

*Adapted from Sylvester-Bradley, 1985. Aspects of Applied Biology 10: 395–400

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