

Unit 17: Crop Production

Delivery guidance

Approaching the unit

This unit is optional for learners taking the Level 3 National Diploma (and other smaller sizes) in Agriculture, and mandatory for those on the Extended Diploma. The unit is designed to give learners the opportunity to recognise a wide range of crop species, understand why crops are grown in certain areas and provide an insight into the fundamentals of crop production. With this unit in particular, learners will benefit from the careful planning of the delivery.

The unit gives learners the opportunity to apply their knowledge of plant science within a practical setting: for example, understanding the importance of plant nutrition and the capture of light by plants to produce dry matter. There are also a number of opportunities to engage with employers, from visiting sites to observing crops being established, grown or stored in a commercial environment, through to visiting end users' premises to see crops being processed. This latter activity could be used to reinforce quality parameters of crop production, and relate these to the choice of species or cultivar at the establishment phase of production. Employers could be invited to the centre to discuss crop production with learners and demonstrate new technology.

A variety of delivery methods can be used when teaching this unit. Delivery is likely to include visits, practicals, and tutor presentations, together with individual and group work. Learners will benefit from practical experience of working with crops and with equipment (such as crop conditioning and handling equipment).

Delivering the learning aims

The unit gives learners the opportunity to recognise a large number of commercially important crops, and to develop an understanding of fundamental concepts such as the location of crop production, production cycles, harvesting, storage and rotations.

Learning aim A

Learning aim A covers crop species grown commercially, their products and where crops are grown. Initially, learners can be encouraged to consider which crops are grown commercially near to the centre, and the reasons why the local area is suitable for growing these particular crops can be discussed. This discussion could be developed further to consider the reasons why some crops are not grown in the local area. It is important that discussions consider factors such as the proximity to end users' premises and transport links, as well as climatic and soil type issues. Tutors can ask learners to produce annotated maps of locations in the UK where specified crops are grown. Consideration should be given to delivering this learning aim and *Unit 1: Plant and Soil Science* simultaneously, or at least carefully sequenced, in order to reinforce the application of the underlying plant and soil science.

Tutors can introduce learners to the quality parameters, and how cultivar choice can be influenced by the quality requirements of the end users of crops. As a starting point, it would be worthwhile initially using important local examples for learners to relate easily to familiar contexts. For instance, is there a cooperative central store, feed mill or maltings in the area? If so, it may be beneficial to the learners to arrange a visit to the premises;

alternatively, a merchant could be invited to provide a talk on where they source various crop products, and explain the quality parameters required by end users. This knowledge could be reinforced by growing small demonstration plots of crops that are less common to the area, and learners could assist with the establishment and growth of these demonstration plots. It may be possible to establish a small experimental plot in this demonstration area, which the learners can manage. The potential use of crop by-products (such as straw for bedding or sugar beet pulp for animal feed) can also be explored. This learning aim can be used to discuss various crop rotations that are appropriate to various situations. You will find it useful to maintain examples of crops and their products to aid learners in identifying crops at different growth and maturity stages. Delivery can include the use of the Agriculture and Horticulture Development Board website and its associated resources.

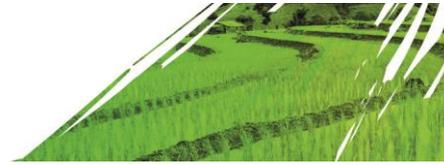
Learning aim B

Learning aim B covers the establishment and growing of crops. Learners will have the opportunity to explore how to maintain a healthy crop, from establishment through to maturity. Tutors should ensure that learners are given the opportunity to apply their understanding of crop physiology and soil science to practical crop production situations. While studying this learning aim, learners must be given the opportunity to identify disorders (including nutrient deficiency symptoms), pests, weeds and diseases of plants in the field, and identify how these problems are rectified in a commercial situation. It is beyond the scope of this unit to actually apply plant protection products or fertiliser; however, it may be possible to integrate the delivery of this unit with other units that do allow the application of such materials. It will be useful to visit farms in the area to view different crop establishment methods, and these visits may be repeated in both the spring and autumn. Tutors may also find it useful to conduct a basic crop trial, possibly using different levels of a nutrient to link in with the demonstration plots mentioned in learning aim A, and the harvesting aspect of learning aim C.

Learning aim C

Learning aim C considers the crop production cycle from harvesting through to delivery to the end user. Tutors will need to carefully consider how learners are to be given the opportunity to be involved with the harvesting of a crop, and crop storage. This may involve monitoring the previous year's crop during the autumn and winter, and observing the crop being harvested the following year. You will need to consider which crops can be grown in order to give the learners the opportunity to undertake practical harvesting operations during term-time. Potatoes, root crops and some fruit crops can be grown for harvesting in the autumn, and forage crops for harvesting in the summer, but it is unlikely that there will be many opportunities to harvest combinable crops. Harvesting can include the loading of produce into a store, so there may be an opportunity to teach this learning aim alongside the units *Unit 23: Land-based Machinery Operations* and *Unit 18: Crop Handling, Storage and Quality Assurance*, where learners can use some of the machinery required for harvesting, and storage of crops can be studied. It is essential that learners are given the opportunity to observe the importance of storing crop products correctly to maintain their quality in a commercial environment. Centres must ensure that learners are given meaningful practical crop harvesting and monitoring experience.

Harvesting could use commercial machinery on the centre's own farm or local site, using equipment such as harvesters, or support machinery, such as trailers. Manual harvesting is allowed by the specifications, but it should be meaningful and represent commercial practice. This could include harvesting delicate fruit or vegetable crops, whose harvesting is not usually mechanised.



The alternative approach would be to harvest demonstration or experimental plots. If the centre decides to use experimental or trial plots, as described in learning aims A and B, it is possible to introduce the learners to the type of manual harvesting methods used by commercial or research organisations: for example, marking out and harvesting 1 m² of a crop (or a set number of tubers, if potatoes are grown).

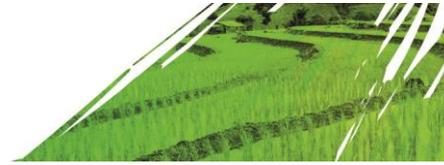
Visits and guest speakers can be useful for learners to understand how professionals in the agriculture sector manage crop harvesting and storage; such speakers could include farmers, store managers or researchers. Learners could compare different crop storage methods across a number of contrasting crops. A useful session could involve monitoring a known local store for temperature, if appropriate, moisture (grain) or wastage (silage), and signs of vermin or pests. This should give all learners the chance to undertake realistic monitoring tasks and could be developed further to consider the automatic or remote sampling technology available commercially.

Assessment model

Learning aim	Key content areas	Recommended assessment approach
A Understand crop species and their products	A1 Crop plants and their products A2 Factors determining crop-growing locations	An illustrated report or presentation examining crop species, their products and where they are grown, supported by a portfolio of evidence relating to the recognition of crop plants and their products.
B Establish and maintain healthy crops throughout the production cycle	B1 The principles of crop establishment B2 The principles of maintaining healthy crops	A report or presentation examining the production, harvesting and storage of crop species, supported by a portfolio of evidence relating to the maintenance of healthy crops and appropriate remedial actions taken when necessary.
C Use accepted working practices to carry out harvesting and crop storage	C1 Safe harvesting of crops C2 The principles of safe storage of crop products	A portfolio of evidence relating to the safe harvesting of crops to meet given objectives, and the safe storage of crop products.

Assessment guidance

This is an internally assessed unit, involving independent learner work. It is suggested that assessment would take place using two, or possibly three, different assignments. The first assignment would concern learning aim A and involve identifying a range of crops grown commercially; why specific crops are grown in specific locations; and determining whether the crops are annual, biennial or perennial. To achieve this learning aim, learners must be able to identify at least 20 crop species. There is no requirement to identify the crops at more than one development stage (although it might be useful to do so during delivery of the unit), so it would be appropriate to assess learners using examples of the crop at maturity, or near maturity, or the harvested product. An identification test could be organised where learners are required to name the specimens presented. If a centre takes this approach, it would be beneficial to choose more than 20 species to identify, so that learners can still demonstrate they can identify 20 species even if they wrongly identify a few examples. It is important to avoid any ambiguous specimens, for example, an awned wheat cultivar, which might be confused with barley, and centres can also be lenient to learners with reference to the two commonly grown species of ryegrass. If there is a locally important crop, such as hops or mushrooms, it is acceptable to use such crops as examples for assessment and delivery purposes. There is a requirement to explain the characteristics to determine whether crops are annual, biennial or perennial. This could be combined with an identification test, or be a separate sub-task that learners prepare prior to the practical identification, and use as part of the identification process. An alternative approach would be to take photographs of the crops, upload these onto the centre's virtual learning environment and ask learners to complete a test on the intranet. The two assessment methods are not mutually exclusive; a combination could be used, or one method could be used for formative assessment, and a different



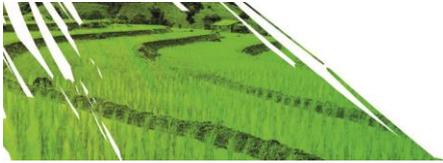
method for summative assessment. If any learner is required to retake this aspect of the unit, a different assessment method could be used: for example, requesting that learners build a portfolio of illustrations – or dried specimens – of crop species.

Learning aim A2 requires learners to know why certain crops are grown in specific areas. In this instance, the use of annotated maps is a potential assessment method. However, tutors need to be mindful that if this method was used as part of the delivery model, the learners cannot simply copy previous work. Learners need to be aware of issues of topography, climate and soil type, for example, by indicating why grassland (particularly rough grassland) is located in areas of high ground, steep slopes and the higher rainfall areas, and why drier areas tend to have more arable crops where there is less rain. Assessment should allow learners to develop this concept further, for example, demonstrating that root and field vegetable crops tend to be grown on freer- draining soils, which makes harvesting easier. At a local level, crops such as sugar beet could be used to illustrate why a crop is grown, or not grown, in a certain area. There are other areas where the soil type and climate are suited to sugar beet production, but they are situated too far from a sugar beet factory to be viable. In some cases, fodder beet for livestock feed is grown in these areas. Growers close to ports also tend to grow specific crops or cultivars for export or transport by sea, when compared to inland areas. At a very local level, a specific end user may specify a certain crop, or quality of crop, that results in a number of growers opting for that particular crop or specific cultivar.

Setting a separate assignment covering learning aim A is useful, as it is not limited to the growing season, particularly if photographs or dried specimens are used for identification purposes. An assignment to cover the rest of the unit is most appropriately set during the spring and summer months, or the summer and autumn.

The assessment of learning aims B and C needs to be carefully planned to coincide with the growing season of the crops chosen, and a robust contingency plan needs to be in place to allow for inclement weather, although the crop monitoring task is less weather dependent. While these two learning aims have been written to allow the learners to follow the crop from establishment through to supply to the end user, there is no requirement for practical tasks to be undertaken with the same crop. For example, one crop could be monitored during the growing season, and a different crop monitored in store. The purpose of this unit is to assess the underlying principles of crop production, and these can be demonstrated with almost any crop.

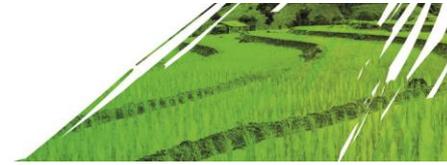
To assess topic B1, tutors must first consider which two contrasting crops the learners are required to produce production cycles for in order to achieve the assessment criteria. Contrasting could mean an autumn-sown and a spring-sown crop, or a crop established by seed and a crop established from vegetative material or transplanting. It would be perfectly possible to allocate different crops to the learners in order to avoid collusion. Learners could be assessed by presentations to the rest of their cohort, written assignments, annotated diagrams or a combination of these methods. The assessment evidence for the maintenance of healthy crops (topic B2) could be derived from the demonstration crops mentioned as a potential delivery and assessment method for learning aim A, or by monitoring commercial crops on the centre's farm or crops established by neighbouring growers. Learners are more likely to be motivated by studying realistic situations, but it must be recognised that it may not be possible to expect all disorders, pests, diseases and weeds to be present, so a contingency plan of photographs and specimens would form a useful, weather-independent 'backup'. The two approaches are not mutually exclusive, and a combination of methods could be used, for example, monitoring weeds in the growing crop, while identifying pests, diseases and disorders via the results of remote sampling and/or photographs, building these into a portfolio of evidence. Commercially available software could be used by the learners to calculate a crop's nutrient requirements, using



data supplied by the centre in order to replicate commercial practice; however, learners must demonstrate understanding of the processes involved in calculating nutrient requirements and be able to interpret the data. Consideration of environmental issues and health and safety must be undertaken at all times, and endorsed by the assessor.

Learning aim C is the most practical of the three learning aims that comprise this unit. To complete learning aim C, learners will need to be able to undertake harvesting, together with practical monitoring of crops in store. To fit in with typical academic years, the crop could be harvested during the late spring, early summer or in the autumn. Crops that match this profile would be grass or maize silage, potatoes, sugar or forage beet, fruit and field vegetables. However, if fruit or vegetable crops are harvested manually, the operation should reflect current commercial practice. Assessment of this unit could use commercial machinery such as forage harvesters and trailers, or – if harvesting of experimental plots is chosen as an alternative – manual harvesting could be used. Maincrop potatoes lend themselves to an experimental approach with manual harvesting, as a given number of tubers can be established per plot, and the discards between plots can be planted with a blue-skinned cultivar to indicate the extent of the plots within rows. The individual rows can be lifted mechanically, and the learners can manually pick and weigh the produce of the plots allocated to them. This approach provides the opportunity to assess the learners' accuracy when measuring the produce. This experimental approach can also be used for other crops, with a m² of crop harvested and weighed.

The monitoring of the harvested crop could be undertaken with a bulk sample in a commercial situation. Whichever crop is chosen, pest and disease presence should be monitored and recorded, and other parameters such as moisture content and temperature can be varied with the crop. It is important that the learners record their findings accurately. While automated systems are often available commercially, learners must understand the concept of monitoring and should be able to demonstrate manual checking techniques, as used commercially by merchants when obtaining a sample from a bulk store for marketing purposes. Learners must work safely at all times, and this should be recorded as an assessor's observation.



Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 17: Crop Production

Introduction

When delivering this unit, there are opportunities to engage learners with the science behind identifying crop plants, and their geographical distribution. The economic geography of the effect of the location of end users, and where crops are grown, is also a useful background concept. Crops are followed logically through the production cycle from establishment to harvest, storage and loading on to vehicles to the end users' premises.

Learning aim A – Understand crop species and their products

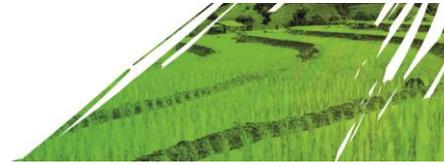
- This unit could be introduced by discussing learners' existing knowledge and experience of crop production, and establishing which crops they can already identify. Peer tutoring in small groups, using crop specimens or photographs, could be a useful starting point.
- Learners could produce a 'card game', or could match photographs on the centre's virtual learning environment, in order to identify which end products are associated with each crop.
- Learners could be encouraged to research the locations of end users' sites in the local area, together with the location of the end user sites for a range of crops nationally. For the latter, each learner (or, if there is a large cohort, pair of learners) could be allocated a crop species, and report back their findings to the cohort via a slide presentation. Some organisations produce interactive maps online. Examples could be projected to the group during classroom sessions.
- Learners could investigate the optimum soil type, topography and climate for various crops; individuals or small groups could research the crops grown on a given soil type and report which crops are grown in various topographic and climatic areas. This information could be presented to the rest of the cohort using a poster or map. To ensure that learners research relevant areas, key titles could be written up on a whiteboard.
- The learning aim can then be summarised with a variety of scenarios. For example, a clay/sandy/peaty soil could be compared with a clay/sandy/peaty soil in another part of the country. Tutors can then discuss with learners which crops might be grown in these scenarios commercially, and why. Learners can then discuss possible crop rotations for each scenario.

Learning aim B – Establish and maintain healthy crops throughout the production cycle

- Learners could be introduced to crop establishment through a tutor-led discussion. This could include a recap of the practical sessions identifying crops in order to suggest the most suitable propagation methods.
- Before moving on to any practical work, the tutor should lead a discussion or short presentation on current legislation and codes of practice relating to crop production and ask learner to comment on why such legislation has been brought in.
- A practical session, along with visits to observe different establishment methods used commercially in the area, would be useful. A class discussion relating to the seed-bed conditions, cultivation methods and the species requirements would provide an insight into the learners' existing knowledge.
- A classroom exercise where learners are shown how to calculate seed rates for various crops and can practise with given examples, could be delivered when inclement weather prevents outdoor practical sessions.
- Learners could be encouraged to research the optimum seed rate and seed dressing options for a crop, and present their findings to the cohort. Ideally, this would be repeated for a spring and an autumn crop.
- Learners should be allocated two contrasting crops to monitor throughout the growing season (or as much of it as term times allow). The contrast could be a perennial crop and an annual crop, a crop that requires protection for some of its growing season with a crop that does not, or two crops with completely different harvesting requirements. The progress of the crops, and any remedial action required, can be reported to the cohort regularly via tutor-guided discussions within class.
- Learners can monitor the crops for weeds, pests and diseases. The learners can also monitor the crops for any disorders or nutrient deficiencies.
- Learners can research the nutrient requirements of the crops and calculate the nutrients that need to be applied to ensure optimal growth.
- Ask learners to think about the role of manipulating plant growth and protected cropping in crop production (using strawberries as an example).

Learning aim C – Use accepted working practices to carry out harvesting and crop storage

- This learning aim can be introduced with a tutor-guided discussion of the different harvesting methods used for crop production. Learners can be prompted by providing images of examples of harvesting machinery and technology.
- A discussion regarding the use of manual harvesting could be developed from a visit to a commercial premise where fruit and vegetables are harvested manually, or partly manually. Alternatively, a researcher or trials officer could be invited to give a talk relating to the manual harvesting of experimental plots.
- Practical sessions should be arranged to allow learners to take part in a harvesting operation. Term times may need to be considered, as to when crops are typically grown and harvested. The latter could be a useful resource to support delivery of the unit, as the harvesting of protected crops is generally less affected by adverse weather conditions.
- The storage of crop products in preparation for sale or use is the final part of the unit, and this topic can be used to complete a tutor-guided journey through the crop production cycle, which provides the opportunity to recap previous parts of the unit.
- The different types of storage methods, grading, cleaning and sorting equipment used commercially can be introduced by a tutor-guided discussion, with the results of the



discussion recorded on a whiteboard. This can be followed with a talk where slides of various types of storage can be shown to the learners and compared with the list on the whiteboard.

- The importance of assurance schemes and how these influence storage requirements can be discussed with a guest speaker, such as a merchant or a manufacturer.
- Crop stores are potentially dangerous working environments: e.g. grain dust, and machinery at work in a confined space. Therefore, before any sites are visited, it is essential to give learners a comprehensive health and safety briefing in the classroom regarding the dangers involved, and to ensure that they have appropriate personal protective equipment (PPE).
- Learners would benefit from visits to local stores and should be asked to research the monitoring systems in place. Cooperative central store operators are often willing to host tours, and can be contacted directly, or via members of the coop. If possible, learners should be given the opportunity to use as much monitoring equipment, technology and associated PPE as possible during these visits.
- Classroom sessions can be used to discuss the logistics of loading and unloading stores safely, before learners are given the opportunity to observe loading and unloading produce from store, and undertake these practical activities themselves.
- Learners should be given the opportunity to visit and work in as many store types as possible. If the centre is based in an area where limited storage types are available, visiting different stores during a study tour would be beneficial.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

This unit links to:

- Unit 1: Plant and Soil Science
- Unit 7: Work Experience in the Land-based Sectors
- Unit 18: Crop Handling, Storage and Quality Assurance
- Unit 19: Combinable Crop Production and Processing
- Unit 20: Grass and Forage Crop Production
- Unit 21: Root Crop and Field Vegetable Production
- Unit 23: Land-based Machinery Operations.

The unit also links to the Level 3 Apprenticeships for Crop Technicians and Packhouse Line Leaders.

Resources

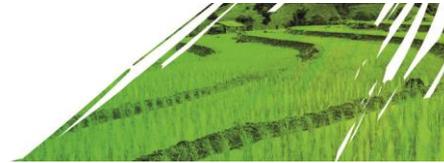
In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Internationals in Agriculture/Horticulture/Land-based subjects. Check the Pearson website (<http://qualifications.pearson.com/endorsed-resources>) for more information as titles achieve endorsement.

Textbooks

AHDB, *AHDB Recommended Lists for Cereals and Oilseeds 2017–18* (new edition published annually), Agricultural and Horticulture Development Board – A complementary publication to that listed above. The publication contains tables listing cultivars of all the main species of cereals and oilseeds recommended for cultivation in the UK, and a commentary explaining the trials methodology and end user requirements. Details are given of pest and disease resistance, together with the quality characteristics of the cultivars listed. This publication is part of a series covering all the main species of crops grown in the UK, and it would be worthwhile obtaining the recommended lists for a number of contrasting crop types.

Department for Environment, Food and Rural Affairs, *Fertiliser Manual (RB209)* (8th Edition), Her Majesty's Stationery Office, 2010 ISBN 9780112432869 – This is the definitive text relating to fertiliser recommendations for the UK. The text explains how fertiliser recommendations are derived, and contains tables from which fertiliser requirements can be calculated for all the main crops grown in the UK. All the programmes written to automatically calculate fertiliser requirements have been developed from the research reported in this text.

NIAB, *Cereals Oilseeds and Pulses* (new edition published annually), NIAB Cambridge, 2017 – One of a series of books published annually, giving recommended cultivars for the species listed, with an explanation of end user requirements and the relative performance of cultivars on different soil types, different points in a rotation, and in different regions. There are sister publications in the same series for other crops, for example, potatoes and forage crops. It would be worthwhile obtaining several books from the series.



Journals

Arable Farming (Briefing Media Ltd, arable crop production) – a monthly journal containing topical articles concerning the main arable crops grown in the UK

Crop Production Magazine (Angus McKirdy, arable crop production) – a journal published 10 times a year, containing contributions from journalists and growers relating to topical crop production issues.

Video

'Camgrain' – click on the 'News and Media' tab and then 'Our Videos' to find the 'Clean wheat plant' video. It explains how wheat is cleaned to meet the food safety requirements of end users in the food manufacturing industry.

Website

'Agriculture and Horticulture Development Board (AHDB)' – website containing information relating to the agricultural and horticultural industry in the UK, including end user requirements, regional issues and the results of experiments and trials.

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.