

Unit 25: Mechanised Agricultural Crop Handling and Storage

Unit code:	T/600/9145
QCF Level 3:	BTEC National
Credit value:	10
Guided learning hours:	60

● Aim and purpose

This unit aims to introduce learners to the skills and knowledge needed for mechanised agricultural crop handling and storage and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

The learner will develop their knowledge and understanding of the efficient handling, conditioning, storage and grading of a range of agricultural crops.

● Unit introduction

The correct storage of crop products is a priority for the agriculture and food industries, particularly with the increasing emphasis on traceability and the requirements of food safety regulations. Historically, the trend has been to handle most crop products in bulk whenever possible, leading to the mechanisation of handling systems. Whichever systems are adopted, the maintenance of product quality is of paramount importance.

This unit will give learners an understanding of the efficient handling, conditioning and storage of a range of products including combinable crops, forage crops, field vegetables, potatoes and sugar beet. Learners will also develop an understanding of the handling, weighing, cleaning and grading systems used for crop products.

The importance of dealing with perishable crops within a prescribed timescale will be emphasised during delivery and assessment of this unit. The unit gives learners the opportunity to consider locally important crops in depth.

● Learning outcomes

On completion of this unit a learner should:

- 1 Know the systems used to maintain combinable crop seeds in store
- 2 Know the processes and systems to maintain harvested root crops in store
- 3 Understand processes and systems to maintain soft fruit, field vegetable or forage crops in store
- 4 Be able to use machinery and equipment used for handling, cleaning, grading and weighing crops.

Unit content

1 Know the systems used to maintain combinable crop seeds in store

Storage parameters: current relevant legislation eg food safety; health and safety; parameters associated with crop deterioration; principles of effective storage systems; crop properties

Storage systems: bulk eg on-floor, cooperative stores, bins and temporary stores; store management; assurance schemes

Drying and conditioning: methods eg batch and bulk drying, cooling, high and low temperature dryer design and operation; volumes and quality of drying and conditioning air; instrumentation for monitoring and control; equilibrium moisture content; fans and airflow characteristics; fuels and heat sources; control of pests and diseases; health and safety; personal protective equipment (PPE)

2 Know the processes and systems to maintain harvested root crops in store

Storage parameters: type eg bulk and box stores, clamps; conditioning; ambient air quality amelioration systems; pest and disease control measures; instrumentation and systems control; refrigeration, temperature regulation; store site management, site design for access, handling and drainage; health and safety; PPE

3 Understand processes and systems to maintain soft fruit, field vegetable or forage crops in store

Types of crop: forage crops eg grass, maize, forage beet; field vegetables eg onions, brassicas, lettuce, vining peas; soft fruit eg strawberries, raspberries

Storage methods and parameters: design eg bulk stores, container stores; conditioning/cooling systems for soft fruit, field vegetables, silage production; deterioration control measures; single or mixed crop storage; pest and disease control; health and safety; PPE

Perishable crops: time management eg excluding air from silage clamps, meeting processors' requirements

4 Be able to use machinery and equipment used for handling, cleaning, grading and weighing crops

Combinable crop equipment: machinery operation eg trailers, chaser bins, bins, floor storage, material handlers, elevators, conveyors, augers, design considerations; combinable crop seed characteristics related to handling; cleaners

Roots, soft fruit, and field vegetables: machinery and equipment eg box and bulk transport systems, box fillers, box handlers, conveyors and elevators; operation; cleaners, loading equipment; documentation eg requirements for factory receipt for sugar beet

Forage crops: machinery and equipment eg trailers, wagons, loaders, grabs, elevators, conveyors, material handlers, chopper blowers; operation

Quality, weighing and grading: machinery and equipment eg requirements and standards for graders, weighing machines, bagging equipment, sizers, washers, brushers, packaging systems; design, siting and installation, selection of equipment for tasks; current relevant legislation

Hygiene, health and safety: requirements and standards; maintenance; safe cleaning/hygiene of storage facilities between crops; PPE; health and safety

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
P1 outline combinable crop drying and storage systems	M1 prioritise factors identified that define appropriate storage conditions for given crops	D1 evaluate grain dryer design in relation to moisture removal/retention for maintaining the quality of combinable crops in storage
P2 describe the factors that define appropriate storage conditions for combinable crops		
P3 describe how storage systems/dryer designs are influenced by the quality requirements of combinable crops in storage [IE, CT, RL]		
P4 outline root crop storage systems	M2 explain and prioritise the criteria used to select appropriate storage methods for root crops	
P5 describe the factors that define appropriate storage conditions for root crops		
P6 describe the criteria used to select appropriate storage methods for root crops		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
P7 explain the processes involved in the storage of selected field scale vegetables, soft fruit or forage crops	M3 for one given field scale vegetable, soft fruit or forage crop, identify and describe the processes involved in its storage	D2 evaluate the storage methods of selected field scale vegetables, soft fruit or forage crops.
P8 discuss control of the deterioration of field scale vegetables, soft fruit or forage crops in store		
P9 operate appropriate equipment for handling, cleaning, grading and weighing selected crops safely [TW, SM, EP]	M4 relate quality requirements of given crops to their handling, cleaning, grading and weighing.	
P10 describe the selection and use of equipment for handling, cleaning, grading and weighing selected crops.		

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers CT – creative thinkers	RL – reflective learners TW – team workers	SM – self-managers EP – effective participators
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Essential guidance for tutors

Delivery

Tutors delivering this unit have opportunities to use a wide range of techniques. Lectures, discussions, seminar presentations, site visits, supervised practicals, internet and/or library-based research and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

It is unlikely that centres will have the range of fixed equipment and machinery to cover all the unit content. It is therefore essential that appropriate use is made of visits, professional speakers from industry and learner research. It is also important that as much practical experience and as many site visits as possible are included.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities are undertaken, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to work in crop storage situations, and they should ask for observation records and/or witness statements to be provided as evidence of this. Suitable examples of witness statements and observation records are to be found on the Edexcel website (www.edexcel.com).

Whichever delivery methods are used, it is essential that tutors stress the importance of sound environmental management and the need to comply with current legislation.

Health and safety issues relating to working with machines, acids, alkalis, pesticides and other hazardous materials must be stressed and reinforced regularly, and risk assessments must be undertaken before any practical activities and before learners visit any commercial crop storage and processing facilities. When working, learners must wear the appropriate PPE and adhere to safe systems of work.

The practical aspects of legislation, together with the health and safety considerations of mechanical crop handling and storage, should be demonstrated, for example the problems associated with working at heights when cleaning a grain store before harvest.

Tutors should consider integrating the delivery, private study and assessment for this unit with other relevant units and assessment instruments learners are taking as part of their programme of study.

Learning outcomes 1, 2 and 3 are directly linked and cover the systems used to maintain produce in storage. Delivery is likely to be in the form of lectures, discussion, site visits, supervised practical sessions and independent learner research. This provides the opportunity to investigate the storage requirements of combinable crops, root crops, soft fruit, and field vegetables or forage crops.

For learning outcome 3, the importance of timeliness when dealing with perishable crops should be emphasised.

Learning outcome 4 covers aspects of cleaning and processing facilities. Delivery is likely to consist of formal lectures, discussion, site visits, supervised practical sessions and independent learner research. Tutors are expected to cover as wide a range of crops as possible, although the opportunity should be taken to research locally important crops in depth. It is essential that safe systems of work are adhered to and that learners are aware of the dangers to themselves to others.

Tutors can be flexible in interpreting which crops are studied. For example, if the centre is not in an area where sugar beet is grown, fodder beet could be considered as either an alternative root crop or as a fodder crop. The requirements of field scale bulb production could also be considered if appropriate to the area.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and overview of unit, testing of prior knowledge.
Theory session on combinable crop drying and storage systems.
Assignment 1: Combinable Crop Storage Systems (P1, P2, P3, M1, D1)
Tutor introduces assignment.
Theory sessions on factors defining appropriate storage conditions.
Theory sessions on crop quality and its influence on storage requirements.
Practical session on combinable crop drying and storage systems – visit to grain store.
Theory follow-up session with Q&A session about the visit and summary.
Assignment 2: Root Crop Storage Systems (P4, P5, P6, M2)
Tutor introduces assignment.
Theory session on processes and systems used to maintain harvested root crops in store.
Practical session on root crop storage to include site visit to store.
Assessment on root crop storage.
Assignment 3: Crop Handling and Storage (P9, P10, M3, M4)
Tutor introduces assignment.
Practical sessions on soft fruit, field vegetable or forage crop storage to include site visit to store.
Theory follow – up session with Q&A about visit and summary.
Theory sessions on soft fruit, field vegetable or forage crop storage.
Assignment 4: Soft Fruit, Field Vegetable/Forage Crop Storage Systems (P7, P8, D2)
Tutor introduces assignment.
Assignment and self-study time.
Practical experience of using a range of equipment.
Individual support.
Unit review.

Assessment

To achieve a pass grade, learners must meet the 10 pass criteria listed in the assessment and grading criteria grid.

For P1, learners must outline combinable crop drying and storage systems. Evidence could take the form of a project or presentation.

For P2, learners must describe the factors that define appropriate storage conditions for combinable crops. Evidence could take the form of a project, presentation or learner responses to verbal questions. Group

work, with individual presentations, may be an appropriate method of ensuring coverage of as wide a range of crops as possible. This may include content being split between the peer group, with joint presentations of findings.

Alternatively, P2 could be assessed directly by the tutor during practical activities. If this format is used then suitable evidence from guided activities would be observation records completed by learners and the tutor. If assessed during a placement, witness statements should be provided by a suitable representative and verified by the tutor.

To achieve P3, learners are required to describe how storage systems/dryer designs are influenced by the quality requirements of combinable crops in storage. Evidence may take the form of written or oral questioning.

To achieve P4, learners need to outline root crop storage systems, for P5 they need to describe the factors that define appropriate storage conditions for root crops, and for P6 describe the criteria used to select appropriate storage methods for root crops. Evidence can be presented in the same format as for P1.

P7 and P8 require learners to explain the processes involved in the storage of selected field scale vegetables, soft fruit or forage crops, and to discuss methods used to control their deterioration. Tutors should identify the crops or agree them through discussion with learners. Where possible, to ensure assessment is fair, the size and complexity of the tasks should be the same for all learners.

As a minimum, learners should provide evidence covering two commercially important crops from the local area. The crops chosen should enable learners to show an understanding of the underlying concepts of crop storage listed in the unit content. Tutors could ensure that at least one of the crops used is perishable (grass for silage can be considered within this category). Evidence can be presented in the same format as for P1.

P9 requires learners to operate appropriate equipment for handling, cleaning, grading and weighing selected crops safely. A major factor must be the safety of both the user and others. Assessment may take the form of short competence tests and observation. Question and answer sessions may be appropriate.

P10 requires learners to describe the selection and use of equipment for handling, cleaning, grading and weighing selected crops. Tutors should identify the crops or agree them through discussion with learners. Where possible, to ensure assessment is fair, the size and complexity of the tasks should be the same for all learners.

Assessors need to ensure that the range of crops chosen demonstrates the principles of these operations as per the unit content. The same crops used for previous grading criteria do not have to be used here. Evidence can be presented in the same format as for P1.

To achieve a merit grade, learners must meet all of the pass grade criteria and the four merit grade criteria.

For M1 learners must identify and prioritise the factors that define appropriate storage conditions for given crops. Learners must describe how storage systems/dryer designs are influenced by the quality requirements of combinable crops in storage. This could build on the knowledge of combinable crop storage needed for P1 and could involve asking learners to demonstrate their understanding of how drying systems can be used to ensure crop quality is maintained. Evidence can be presented in the same format as for P1.

M2 requires learners to explain and prioritise the criteria used to select appropriate storage methods for root crops. Learners must demonstrate, within a given timescale, the ability to report the parameters required to store a selected field scale vegetable, soft fruit or forage crops successfully. Where possible, to ensure assessment is fair, the size and complexity of the tasks should be the same for all learners.

Tutors are encouraged to simulate industry conditions by setting an assessment within a specified timescale, ensuring learners can meet industry deadlines. This could be achieved using time-constrained research assignments.

For M3, learners must identify and describe the process involved in the storage of a field scale vegetable, soft fruit or forage crop. Tutors should identify the crops or agree them through discussion with learners. Where

possible, to ensure assessment is fair the size and complexity of the tasks should be the same for all learners. Evidence can be in the same format as for P1.

For M4, learners need to relate quality requirements of selected crops to their handling, cleaning, grading and weighing. Tutors should identify the crops or agree them through discussion with learners. Where possible, to ensure assessment is fair, the size and complexity of the tasks should be the same for all learners. Learners should justify their choice of equipment to handle, clean, grade and weigh crops. Evidence can be presented in the same format as for D1. Alternatively, it could take the form of a written project. Preference should be given to a presentation where the information can be shared with the peer group.

To achieve a distinction grade learners must meet all of the pass and merit grade criteria and the two distinction grade criteria.

For D1, learners must evaluate grain dryer design in relation to moisture removal/retention for maintaining the quality of combinable crops in storage.

Learners will evaluate issues such as ease of loading and unloading, throughput and possible effects on quality (for example the effects of drying temperatures on seed germination). Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector) or a project.

For D2, learners need to evaluate the storage methods of selected field scale vegetables, soft fruit or forage crops. Tutors should identify the crops or agree them through discussion with learners. Where possible, to ensure assessment is fair, the size and complexity of the tasks should be the same for all learners. Learners must identify alternative methods, identify strengths and weaknesses and relate these to storage and quality requirements. Evidence can be presented in the same format as for D1. Alternatively, it could take the form of a written project. Preference should be given to a presentation where the information can be shared with the peer group.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, M1, D1	Combinable Crop Storage Systems	Review of systems for the drying and storage of combinable crops.	Report supported by presentation.
P4, P5, P6, M2	Root Crop Storage Systems	For an agreed root crop identify and review systems for drying and storage.	Oral test.
P9, P10, M3, M4	Crop Handling and Storage	For an agreed crop or crops identify and review storage systems.	Witness statements. Observation records.
P7, P8, D2	Soft Fruit, Field Vegetable/Forage Crop Storage Systems	Practical task assessed in context. Emphasis on safe working.	Assignment.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
Assist with Agricultural Crop Production	Element AgC12.1 Maintain and control harvesting operations
Introduction to Grass and Forage Crop Production	Undertake Agricultural Crop Production

Essential resources

Learners will need access to appropriate resources, either at the centre or at nearby commercial premises. Facilities for this unit must include access to a range of crop storage and handling resources. If only basic facilities are available at the centre, transport must be provided for study tours to allow learners to observe the latest commercial facilities.

It would be beneficial if learners had the opportunity to visit shows or demonstrations where the latest commercially available mechanical crop handling and storage facilities are displayed.

Tutors delivering this unit should possess a suitable agricultural or engineering qualification, and must have the opportunity to undertake appropriate technical updating and develop links with local employers. Tutors must also be given the opportunity to keep themselves technically up to date in relation to food safety, environmental and health and safety legislation.

Sufficient library and IT resources regarding a range of crop storage and handling techniques should be available for learner reference.

Employer engagement and vocational contexts

Centres are encouraged to develop links with local pack-houses, stores and industry representatives who can support the breadth of this unit. These employers can provide work-based practical experience with a range of agricultural crops, storage machinery and equipment. Guest speakers and visiting experts can be used to support the learning experience. Employer engagement will ensure the use of technically up-to-date information and processes.

Indicative reading for learners

Textbooks

Booder D, Bakker-Arkema F and Hall C – *Drying and Storage of Grains and Oilseed, 2nd Edition* (Kluwer Academic Publishers, 1992) ISBN 0442205155

Chaney K – *Integrated Farm Management and Sustainable Systems* (Blackwell Science, 2007) ISBN 0632064234

Langdon D – *Spon's External Works and Landscape Price Book* (Taylor & Francis, 2006) ISBN 0415393841

National Institute for Research in Dairying – *Silage for Milk Production* (National Institute for Research in Dairying, 1982) ISBN 070840166X

Nix J – *Farm Management Pocketbook* (The Andersons Centre, 2006) ISBN 0954120159

Soffe R – *The Agricultural Notebook, 20th Edition* (Blackwell Science, 2003) ISBN 0632058293

Watson D – *Cost Effective Purchasing of Building Materials: A Guide to Purchasing for Small Building Projects* (Spon Press, 1999) ISBN 0419247408

Witney B – *Choosing and Using Farm Machines* (Land Technology, 1995) ISBN 0952559609

Other publications

Code of Practice for the Control of Salmonella (DEFRA, 2003)

Grain Sampling – *A Farmer's Guide* (Home Grown Cereals Authority, 2003)

The Grain Store Guide (Home Grown Cereals Authority, 2003)

Farm-Electric Centre – *Grain Drying and Storage* (Farm-Electric Centre, 1982)

Farm-Electric Centre – *Potato Storage* (Farm-Electric Centre, 1983)

Journals

British Sugar Review

Crops

Farm Building Progress

Farm Contractor

Farmers Weekly

Journal of Agricultural Engineering Research (JAER)

Landwards

Transactions of the American Society of Agricultural Engineers (Trans ASAE)

Websites

www.bsonline.co.uk

British Sugar

www.environment-agency.gov.uk

Environment Agency

www.hgca.com

Home Grown Cereals Authority

www.potato.org.uk

British Potato Society

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are ...
Independent enquirers	researching information on systems
Creative thinkers	devising and identifying suitable systems for storage
Reflective learners	comparing and contrasting systems
Team workers	investigating systems on site visits
Self-managers	carrying out assignments to timescales
Effective participators	participating in theory and question and answer sessions participating in presentations carrying out practical tasks for handling, cleaning, grading and weighing selected crops.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Creative thinkers	generating ideas for storage systems
Reflective learners	analysing their own performance and contribution to learning.