Unit 28: Understand and Use Agricultural Spreaders and Sprayers

Unit code: A/600/9132

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 agricultural spreaders and sprayers, 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 an awareness of the equipment and techniques used to apply agri-chemicals and fertilisers, the routine maintenance and use of sprayers and spreaders, and the legislation that applies to their operation. They will develop practical skills needed to safely operate and maintain sprayers and spreaders and investigate the impact of developments in agricultural application machinery on operator safety, the wider environment and the effects on the perception of modern agricultural practices.

Unit introduction

Successful grassland and arable farming depend on the application of agri-chemicals to promote growth and control pests/diseases/disorders. Carrying this out in an environmentally sustainable manner, whilst protecting the environment, depends on the safe, effective and efficient application of these products.

Learners wishing to follow a management career in agriculture must be able to operate this type of equipment to meet industry guidelines, whilst maximising efficiency and effectiveness. Essentially, operations need to be completed in a way that minimises the risk to the operator and the wider environment.

This unit focuses on the application of agri-chemicals using sprayers and spreaders. Learners will be involved in the routine maintenance and use of sprayers and spreaders. They will look at the factors that affect the efficiency and accuracy of operations and at the technology behind the equipment.

The application of agri-chemicals using sprayers and spreaders is strictly controlled by legislation to protect both the environment and the operator. Throughout the unit learners will be made aware of the legislation controlling the use of chemicals, health and safety and the environmental concerns associated with the use of agri-chemicals on food crops, and the effects, on public perception of modern agricultural practices.

Learning outcomes

On completion of this unit a learner should:

1. Understand how machinery is used for the application of pesticides and fertilisers to agricultural crops
2. Be able to prepare, operate and maintain application and spreading machinery
3. Know the factors affecting efficiency and accuracy of pesticide and fertiliser placement
4. Know the impact of developments in application technology on operator safety and environmental protection standards.

Unit content

1. Understand how machinery is used for the application of pesticides and fertilisers to agricultural crops

General operation: legal requirements eg FEPA, PUWER; codes of practice eg individual relevant codes of good agricultural practice for soil, water and air; industry schemes eg National Register of Sprayer Operators (NRoSO), National Sprayer Testing Scheme (NSTS), Voluntary Initiative (VI); safe and efficient working practices eg attaching, filling, calibration, field operation, cleaning, repair and maintenance; health and safety; risk assessments eg local environmental risk assessments for pesticides (LERAPs)

Crop sprayers: types eg hydraulic nozzle, twin fluid nozzle, downward air assistance; components; operation; spray pattern; fault finding; maintenance; health and safety; compliance with current legislation

Fertiliser spreaders: types eg spinning disc, oscillating spout, pneumatic, full width, variable rate; components; operation; spread pattern; fault finding; maintenance; health and safety; specialised headland application methods for compliance with current legislation

2. Be able to prepare, operate and maintain application and spreading machinery

Practical ability: preparation of equipment for use; calibration eg principles, automatic calibration, weigh cells; safe driving; site work; programming machine software, fault finding; post-operation maintenance; safe storage of machinery after use; health and safety; personal protective equipment (PPE); compliance with current legislation

Machinery: fertiliser spreaders eg spinning disc, oscillating spout; crop sprayers eg hydraulic nozzle, twin fluid nozzle, downward air assistance; health and safety (operator safety); environmental protection

3. Know the factors affecting efficiency and accuracy of pesticide and fertiliser placement

Factors: machine type; application method; height; bout width; overlap; environmental considerations eg habitats, drainage, soil indices; field conditions; weather; properties of materials being applied eg physical form, size, consistency

4. Know the impact of developments in application technology on operator safety and environmental protection standards

Trends and developments: ongoing research and development eg air-assistance, electrostatics, twin fluid, controlled droplet application, closed transfer systems, contamination risk reduction, the use of global positioning satellites (GPS), precision farming

Environmental considerations: current relevant legislation eg Food and Environment Protection Act 1985 (FEPA), Control of Pesticides Regulations 1986 (COPR) (as amended); safe storage and handling of materials; European Union requirements eg Nitrogen Vulnerable Zones (NVZs); voluntary schemes eg Voluntary Initiative, crop management plans (CMPs); requirements of crop assurance schemes; air, soil and water contamination; health risks (real and perceived); label and specific off-label recommendations; public perceptions and concerns

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 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 explain the operation of selected machinery to apply agri-chemicals and fertilisers to agricultural crops [EP,RL]		
P2 evaluate the use of different machinery in the application of pesticides and fertilisers to agricultural crops	**M1** assess the relative merits of the types of machinery used to apply pesticides and fertilisers to agricultural crops	
P3 ensure equipment is prepared in a safe and effective condition	**M2** complete risk assessments for personal safety and environmental impact before using selected application equipment	
P4 safely operate application machinery to meet given objectives	**M3** calibrate machinery used to apply pesticides and fertilisers to meet given objectives	**D1** explain how application machinery can be prepared, operated and maintained to ensure efficient performance whilst minimising risks to health and safety and the environment
P5 safely maintain application machinery to meet given objectives		
P6 describe variables affecting the efficiency and accuracy of pesticide and fertiliser placement	**M4** describe the factors that affect the efficiency and accuracy of pesticide and fertiliser placement	**D2** identify the impact of changing variables on the efficiency and accuracy of pesticide and fertiliser placement
P7 identify impacts of changing variables on efficiency and accuracy of pesticide and fertiliser placement [SM]		

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:**
P8 describe impacts of developments in application technology on operator safety		
P9 describe impacts of developments in application technology on environmental protection standards [IE]	**M5** describe how these developments have been used in the development of machines for spraying and spreading agricultural crops.	**D3** evaluate different machinery in terms of operator safety, environmental protection and its role in applying agri-chemicals in given situations.
P10 identify legislation relevant to the application of pesticides and fertilisers.		

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	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

To study this unit, learners need to be competent in the use of machinery, particularly tractors.

The unit has been designed to give learners the knowledge and practical skills they need to operate both a spreader and a sprayer and learners need adequate time to become familiar with using the equipment.

As a minimum, learners should be familiar with the detailed operation of one type of crop sprayer and one type of fertiliser spreader, although learners will obviously benefit from a wider exposure.

Learners will benefit from attending specialist trade events and shows where they should be able to view a wider range of application equipment.

To enable learners to calibrate and carry out routine maintenance of spreaders and sprayers it is essential that learners have access to manufacturers' instruction manuals, in hard copy or electronic format. These, together with specialist trade press and journals, will be a useful source of information on current trends and developments in the sector.

Health and safety and environmental protection are important themes within this unit and it is essential that tutors address the significant hazards associated with the operation of agricultural machinery before any practical work is carried out. Health and safety issues related to working with fertilisers and agri-chemicals must be stressed and reinforced regularly, and risk assessments must be undertaken before any practical activities. Following the production of suitable risk assessments appropriate PPE must be provided and used.

Learners will become aware of the legal aspects associated with the application of agri-chemicals and fertilisers. It is therefore important for tutors to keep up to date regarding ongoing changes and developments in this area. Learners will study the range of equipment available to apply agri-chemicals and fertilisers effectively.

Tutors must ensure that learners are aware of all current codes of practice and must stress the importance of good environmental practice and the need to comply with all relevant current legislation.

The legalities of operating crop sprayers and spreaders need to be understood and complied with during delivery. Centres may choose to link delivery of this unit with training towards the achievement of a relevant FEPA qualification, for example PA2A.

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 the unit.
Assignment 1: Operation of Selected Machinery (P1, P2, M1) Tutor introduces the assignment.

Topic and suggested assignments/activities and/assessment
Health and safety and environmental protection legislation and codes of practice relating to the use of agri-chemicals and fertilisers.
Components of sprayers and how they operate.
Components of spreaders and how they operate.
Factors that impact on the efficiency of spreading/spraying.
Practical operation of sprayers and spreaders.
Assignment 2: Safe Application of Agri-Chemicals Using a Spreader (P3, P4, P5, P6, P7, P10, M2, M3, M4, D1, D2) Tutor introduces assignment.
Assignment 3: Safe Application of Agri-Chemicals Using a Sprayer (P3, P4, P5, P6, P7, P10, M2, M3, M4, D1, D2) Tutor introduces assignment.
Assignment 4: Technological Advances (P8, P9, M5, D3) Tutor introduces assignment.
Technological advances in sprayer/spreaders and how environmental protection and operator safety issues are addressed.
Unit review.

Assessment

For P1 and P2, learners need to show that they understand how spreaders and sprayers work and evaluate the use of different machinery. This will involve the production of a labelled diagram detailing each component with a description of how the component works.

P3, P4 and P5 relate to the safe use of spreaders and sprayers. For P3, learners must prepare a sprayer and a spreader for use. The machines used should be makes and models that learners are familiar with. In preparing the machines for use learners should refer to the manufacturer's instruction manual, which should also be used to identify any routine maintenance that needs to be completed. Health and safety is an important consideration in the use of any farm machinery, and learners need to observe safe working practices in completing this task. For P4, learners must use a spreader and a sprayer in realistic situations which should be specified by the tutor. On completion, the sprayer and spreader should be maintained and prepared for storage as specified in the manufacturer's instruction manual. This will provide evidence for P5. Alternatively, certificates for the FEPA Certificate of Competence tests PA1 and PA2 or PA6 can be used as evidence of the safe use of a sprayer

P6 and P7 relate to the placement of fertilisers and agri-chemicals and learners need to understand the technology underpinning the operation of spreaders and sprayers and the nature of the chemicals being spread. For P6, learners are required to consider the factors that affect the efficiency and accuracy of fertiliser and agri-chemical placement. For P7, they need to consider how changing these variables impacts on placement.

P8, P9 and P10 have a common theme, that of operator and environmental safety. For P8 and P9, learners need to identify the technological developments that have taken place to improve operator safety and environmental protection, and describe the impact of these developments. For P10, learners need to identify the legislation and codes of practice that impact on the use of sprayers and spreaders, describing their implications for businesses and manufacturers.

For M1 learners need to consider the relative merits of the types of machinery used to apply pesticides and

fertilisers to agricultural crops. They could produce a checklist against which different types of machine could be evaluated.

For M2, learners need to complete a risk assessment before using a selected sprayer and spreader. Many centres have existing generic risk assessments, and learners should be able to take a generic risk assessment and contextualise it for the machines to be used and the circumstances they will be operating in.

For M3, learners must be able to calibrate sprayers and spreaders for different chemicals, application rates and conditions of use. They must understand how to adjust the machines so that application rates are changed, and why changes in circumstances impact on the operation of sprayers and spreaders.

For M4, learners must consider the factors that affect fertiliser and agri-chemical placement by building on the information provided for P6. They will look in detail at how placement mechanisms operate, and the factors influencing their function.

For M5, learners will consider a range of technological improvements, how industry has applied them and the contribution they have made to improved safety.

D1 builds on the evidence produced for P4 and M1 where learners prepared spreaders and sprayers for use. In D1 learners should take key aspects of preparing machines for use and explain how these parts of the machines, and they are prepared for use, contribute to efficient performance and minimise health and safety risks.

For D2, learners need to identify the factors that impact on the efficiency and accuracy of agri-chemical and fertiliser placement. The relative importance of each factor needs to be considered and how its impact can be minimised. Learners will produce a series of guidelines showing how fertilisers and agri-chemicals can be placed efficiently and accurately

For D3, learners must assess how effective technological improvements have been in promoting operator safety and environmental protection. Learners need to evaluate the strengths and weaknesses of commonly available machines and, for each machine, make recommendations regarding which machines provide the greatest environmental and operator protection.

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, M1	Operation of Selected Machinery	Select a model of spreader and a model of a sprayer. For each, produce a detailed chart showing the constituent parts.	Written evidence. Poster showing the operation of a spreader and a sprayer.
P3, P4, P5, P6, P7, P10, M2, M3, M4, D1, D2	Safe Application of Nutrients and Agri-Chemicals Using a Spreader and a Sprayer	Using a given piece of equipment, prepare it for use, carry out routine maintenance, calibrate the equipment, use it (in a real situation or a simulation), clean and store it after use.	Completed observation checklists. Certificate covering PA1 and PA2 for safe use of a sprayer.
P8, P9, M5, D3	Technological Advances	Review how legislation has driven technological advances that have improved operator safety and environmental protection.	Written evidence.

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
Introduction to Land-based Machinery Operations	Understanding Principles of Land-based Machinery
Introduction to Principles of Land-based Machinery	Element CU28.1 Prepare equipment and machines for maintenance Element CU28.2 Maintain and repair equipment and machines

Essential resources

Learners will need access to at least one type of crop sprayer and one type of fertiliser spreader (with appropriate tractors to operate both machines if they are not self-propelled). Manufacturers' manuals should be available to learners.

Access to other examples of application equipment, including working models and sectioned components, will benefit learners. Appropriate crops, such as grass and cereals, will be required for learners to work on, as will sufficient non-cropping areas (for example hardcore, concrete) to allow learners to complete trial settings and calibrations.

Calibration kits and tray tests will be required for all types of machinery used. Workshop facilities with basic service and maintenance tools should be available to facilitate the preparation of equipment and post-use maintenance. It is essential that all relevant PPE and health and safety equipment is available to all learners during practicals.

Tutors delivering this unit should be competent and experienced machinery operators.

Employer engagement and vocational contexts

This unit focuses on the practical aspects of sprayers and spreaders and will give learners an understanding of how they work to underpin the skills needed to operate these machines.

Centres need to develop links with local machinery dealers and manufacturers to give learners access to a broad range of equipment, so they are aware of developments in the industry. This could be via guest lecturers, visits to manufacturers, local shows and machinery dealerships.

Links with the Health and Safety Executive and environmental groups will also give learners opportunities to appreciate the importance that specialist interest groups place on the safe use of agri-chemicals and specialist machinery.

Indicative reading for learners

Textbooks

Bell B – *Farm Workshop, 2nd Edition* (Farming Press, 1992) ISBN 0852362374

Mathews G – *Pesticide Application Methods, 3rd Edition* (Blackwell Science, 2000) ISBN 0632054735

Riby H – *Using Pesticides: A Complete Guide to Safe, Effective Spraying, 2nd Edition* (BCPC Publications, 1999) ISBN 1901396010

Other publications

Defra – *Code of Good Agricultural Practice for the Protection of Air* (The air code) (MAFF, 1998) PB0618

Defra – *Code of Good Agricultural Practice for the Protection of Soil* (The soil code) (MAFF, 1998) PB0617

Defra – *Code of Good Agricultural Practice for the Protection of Water* (The water code) (MAFF, 1998) PB0587

Defra – *Code of Practice for Using Plant Protection Products* (DEFRA, 2006) ISBN 0855211709

Websites

nroso.nptc.org.uk	National Register of Sprayer Operators
www.aea.uk.com/sprayer/index.htm	National Sprayer Testing Scheme
www.bcpc.org	British Crop Protection Council
www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.environment-agency.gov.uk	Environment Agency
www.hsegov.uk	Health and Safety Executive
www.voluntaryinitiative.org.uk	The Voluntary Initiative

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	investigating technological advances used to protect the operator and environment engaging with tutors when working with spreaders and sprayers
Reflective learners	setting achievement goals for practical assessments in the use of sprayers and spreaders using feedback from tutors to improve performance
Self-managers	using initiative and self-motivation to prepare coursework
Effective participators	participating in classroom activities.

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 ...
Independent enquirers	researching environmental constraints on the application of fertilisers and agri-chemicals
Creative thinkers	applying techniques, developed using one piece of equipment, to different machines solving problems when setting up sprayers for use
Reflective learners	analysing their performance based on feedback from assessors identifying development targets for future performance
Team workers	working with colleagues to carry out routine maintenance of machinery
Self-managers	managing own time when completing coursework
Effective participators	participating in practical activities.

Functional Skills – Level 2

Skill	When learners are ...
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	researching assignments on the internet
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	managing written assignments using ICT
Follow and understand the need for safety and security practices	
Troubleshoot	
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	researching assignments on the internet
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	researching assignments on the internet
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	preparing written assignments using ICT
Bring together information to suit content and purpose	preparing written assignments using ICT
Present information in ways that are fit for purpose and audience	preparing written assignments using ICT
Evaluate the selection and use of ICT tools and facilities used to present information	
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	preparing written assignments using ICT

Skill	When learners are ...
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	using formulae to calculate application rates for sprayers and spreaders
Identify the situation or problem and the mathematical methods needed to tackle it	calibrating a sprayer for a specified application rate of a given chemical/substitute
Select and apply a range of skills to find solutions	
Use appropriate checking procedures and evaluate their effectiveness at each stage	calibrating a sprayer
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	
Draw conclusions and provide mathematical justifications	
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	describing the activities being undertaken as part of the practical assessments in this unit
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	reading sprayer and spreader manuals and using them to gather information about calibration and maintenance
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	completing written assignments.