Lantra

The Sector Skills Council for the environmental and land-based sector

Skills for Work: **Rural Skills Intermediate 1**

Crop Production: An Introduction (Agriculture)

Support Material

September 2006

SFEU

Scottish Further Education Unit

Acknowledgements

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SFEU is also grateful for the contribution of the Scottish Qualifications Authority in the compilation of these materials, specifically for its permission to reproduce extracts from Course and Unit Specifications and the Skills for Work Rationale.

Rural Skills: Crop Production: An Introduction (Agriculture), Intermediate 1

DX12 10

Introduction

These notes are provided to support teachers and lecturers presenting the Scottish Qualifications Authority Unit DX12 10 Rural Skills: Crop Production: An Introduction (Agriculture).

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Further information regarding this Unit including Unit Specification, National Assessment Bank materials, Centre Approval and certification can be obtained from:

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Reference Section

Contents

What are Skills for Work Courses all about?

Skills for Work Courses are designed to help candidates to develop:

- skills and knowledge in a broad vocational area
- Core Skills
- an understanding of the workplace
- positive attitudes to learning
- skills and attitudes for employability

A key feature of these Courses is the emphasis on **experiential learning**. This means learning through practical experience and learning by reflecting on experience.

Learning through practical experience

Teaching/learning programmes should include some or all of the following:

- learning in real or simulated workplace settings
- learning through role play activities in vocational contexts
- carrying out case study work
- planning and carrying out practical tasks and assignments

Learning through reflecting at all stages of the experience

Teaching/learning programmes should include some or all of the following:

- preparing and planning for the experience
- taking stock throughout the experience
- reviewing and adapting as necessary
- reflecting after the activity has been completed
- evaluating, self-assessing and identifying learning points

The Skills for Work Courses are also designed to provide candidates with opportunities for developing **Core Skills** and enhancing skills and attitudes for **employability**.

Core Skills

The five Core Skills are:

- Communication
- Numeracy
- Information Technology
- Problem Solving
- Working with Others

Employability

The skills and attitudes for employability, including self-employment, are outlined below:

- **generic skills/attitudes valued by employers**
    - understanding of the workplace and the employee's responsibilities, for example time-keeping, appearance, customer care
    - self-evaluation skills
    - positive attitude to learning
    - flexible approaches to solving problems
    - adaptability and positive attitude to change
    - confidence to set goals, reflect and learn from experience

- **specific vocational skills/knowledge**
    - Course Specifications highlight the links to National Occupational Standards in the vocational area and identify progression opportunities

Opportunities for developing these skills and attitudes are highlighted in each of the Course and Unit Specifications. These opportunities include giving young people direct access to workplace experiences or, through partnership arrangements, providing different learning environments and experiences which simulate aspects of the workplace. These experiences might include visits, visiting speakers, role play and other practical activities.

A Curriculum for Excellence (Scottish Executive 2004) identifies aspirations for every young person. These are that they should become:

- successful learners
- confident individuals
- responsible citizens
- effective contributors

The learning environments, the focus on experiential learning and the opportunities to develop employability and Core Skills in these Courses contribute to meeting these aspirations.

The Course in Rural Skills (Intermediate 1)

Course Rationale

The land-based sector is very diverse and includes a wide number of disciplines that share a common element of being active, practical and mainly based outdoors. The major disciplines that are recognised as land-based by the sector skills council for the area include the following: agricultural crops; fencing industries; land-based engineering industries; production horticulture industries; tree and timber related industries; environmental conservation industries; landscaping industries; agricultural livestock; animal care industries; aquaculture; equine industries; farriery; fisheries management; game and wildlife management and veterinary industries.

There is a very wide range of land-based businesses in Scotland with a great variety of job roles. Changes in rural land use, including the decline and change of traditional agriculture, have created a knowledge gap. Research has indicated that fewer people are likely to contribute to the rural economy and its development unless more individuals are introduced to the possible opportunities in land-based industries in the UK.

This Rural Skills Course has been designed to provide a broad basis for progression into further education and training in the land-based sector. It allows candidates to begin to develop some of the basic practical skills necessary to work in most of these disciplines as well as an opportunity to explore the very diverse employment prospects that exist.

The primary target group for the course is school candidates in S3 and S4. It is anticipated that, for this group of candidates, the course will rely on and build on existing partnerships between schools and further education colleges delivering specialisms in land-based industries. It may also be delivered in conjunction with training providers or employers specialising in the land-based industries. These partnerships will enable the course to be delivered in a variety of appropriate learning environments with access to relevant teaching expertise.

The course has been designed with a common core that allows candidates to develop an insight into the numerous opportunities of the land-based industries and to develop the basic common skills of the sector. It also allows candidates to choose a route that is related to either animals or plants where they can develop specific basic practical skills in that general category.

The general aims of the course are to:

- widen participation in vocationally-related learning for 14–16 year olds
- allow candidates to experience vocationally-related learning
- provide candidates with a broad introduction to the land-based sector

- encourage candidates to develop a good work ethic including reliability, flexibility and a positive attitude to work
- provide opportunities to develop Core Skills in a realistic context
- encourage candidates to take charge of their own learning and development
- provide a range of teaching, learning and assessment styles to motivate candidates to achieve their full potential
- facilitate progression to further education and/or training

The specific aims of this course are to:

- introduce candidates to the various disciplines of the land-based sector
- allow candidates to develop a basic knowledge of a selection of land-based industries and related job roles
- allow candidates to experience an outdoor working environment
- allow candidates to develop an understanding of the very flexible requirements of the individual who works with plants and/or animals
- allow candidates to develop an awareness of health and safety issues that are integral to a career in a land-based industry
- allow candidates to develop the technical knowledge, skills and understanding of some of the commonly used practical skills associated with land-based industries at this level
- introduce candidates to the technical knowledge, skills and understanding of some specific practical skills associated with a selection of land-based industries at this level
- prepare candidates for more focused further learning opportunities, study and training for employment in land-based industries

Unit Outcomes, PCs and Evidence Requirements

Unit Specification: Statement of Standards

Unit: Crop Production: An Introduction (Intermediate 1)

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

Outcome 1

Assist with preparing the site/growing medium and establishing a selected crop.

Performance Criteria

a) Assist with preparing the site/growing medium for growing the crop.

b) Assist with establishing the crop in the growing medium.

c) Demonstrate safe working practices.

Outcome 2

Assist with maintaining the healthy growth of a selected crop.

Performance Criteria

a) Assist with monitoring the progress and health of the crop.

b) Assist with procedures to maintain the healthy growth of the crop.

c) Demonstrate safe working practices.

Outcome 3

Demonstrate knowledge and understanding in relation to selecting, establishing and maintaining a selected crop.

Performance Criteria

a) State the reason for growing the selected crop.

b) State basic requirements for growth of the selected crop.

c) Identify the stages of production of the selected crop.

d) Identify signs of damage or disease to the selected crop.

Evidence Requirements For This Unit

Performance evidence supported by an assessor observation checklist together with written and/or recorded oral evidence is required to show that all Outcomes and Performance Criteria have been achieved.

Evidence must be gathered in an appropriate context where live crops are kept in working environments or simulated working environments.

In relation to Outcomes 1 and 2 evidence is required in relation to **one or more crop/s** from the following categories:

- arable crops
- silage and fodder crops
- biomass energy crops
- field-grown vegetables
- field-grown fruit
- protected edible crops
- protected non-edible crops
- ornamental nursery stock
- bedding plants
- forestry tree nurseries

The assessor observation checklist confirms that the candidate has:

- assisted with preparing the site
- assisted with establishing the crop
- assisted with monitoring the health and progress of the crop
- assisted with maintaining the healthy growth of the crop
- demonstrated safe working practices throughout

In relation to Outcome 3, evidence must relate to only one crop from the above list. Written and/or oral evidence should be noted in a record sheet, and should include:

- a statement of the reason for growing the crop
- a statement of the basic requirements of one crop
- identification of the stages of production of this crop
- identification of signs of damage or disease to this crop

The item for this Unit contains assessor observation checklist and a record sheet for the written or recorded oral evidence. The NAB illustrates the national standard required for this Unit. Centres who wish to devise their own assessments should refer to the NAB to ensure a comparable standard.

NB Centres must refer to the full Unit Specification for detailed information related to this Unit.

Employability Skills Profile: Rural Skills (Intermediate 1)

Land Based Industries: An Introduction	**= A**
Estate Maintenance: An Introduction	**= B**
Employability Skills for land based industries	**= C**
Animal Husbandry: An Introduction	**= D**
Animal Handling: An Introduction	**= E**
Crop Production: An Introduction	**= F**
Soft Landscaping: An Introduction	**= G**

In addition to the specific, vocational skills developed and assessed in this Course, employability skills are addressed as detailed below:	
Employability skill/attitude	**Evidence**
• acceptable time keeping and attendance	C
• understanding roles and responsibilities in the workplace	A
• planning and preparing for work	A, C
• working co-operatively with others	A, C, D, E, F, G
• awareness of efficient resource use	C
• ability to follow instructions	A,B,C, D, E, F, G
• health and safety awareness	B, C, D, E, F, G
• self review and evaluation	A, C
• positive attitude to learning	C

Assessment evidence:

A = Portfolio containing candidate planning and review sheets and assessor checklists

B = Assessor checklists of practical tasks undertaken

C = Candidate/assessor review sheets, risk examination log

D = Assessor checklists and candidate log sheets of practical tasks undertaken

E = Assessor checklists and candidate log sheets of practical tasks undertaken

F = Assessor checklists and candidate log sheets of practical tasks undertaken

G = Assessor checklists and candidate log sheets of practical tasks undertaken

Tutor Support Section

How to use this pack

This pack comes in two sections.

In the first section advice is given to tutors on the following:

- general Guidance on Unit delivery
- signposting of Employability Skills as they occur within the Unit
- guidance on *Integrating the Employability Skills for Land-based Industries* Unit as well as generic employability skills, qualities and attitudes throughout the Unit
- advice on where it would be appropriate to collect evidence for the assessment of employability skills
- resource requirements in terms of physical resources and recommended texts or supplementary resources
- a suggested learning programme
- guidance on Learning and Teaching with under 16s

In the second section, student support notes are provided which include the following:

- materials relating to the knowledge, understanding and practical skills of the Unit
- some interactive student activities accompanied by exemplar answers for student referral or tutor use following activity
- some self evaluation/reflection tasks following activities as appropriate
- a self-assessment area for students to test their own knowledge and understanding
- a glossary of topic specific terminology for student referral

Tutors should note that this is not designed as a complete teaching pack. The student notes are intended to support the teaching process, give guidance as to the level of knowledge and understanding that is expected and give the student opportunity to reinforce and self-review what they have learnt. They are not designed to be a substitute for practical activity but are a useful adjunct to it. Use of the materials and activities is not mandatory but they will provide centres with a flexible set of materials which can be selected, adapted and used in an order that best suits their situation. Tutors are encouraged to use the materials creatively in ways which will engage the younger student.

You may wish to place the student notes on your own Intranet by downloading this pack from the *Skills for Work* section of the SFEU website www.sfeu.ac.uk. On the web-based version, the hyperlinks are live and there is a link between emboldened terms to the Glossary of terms, which may be useful for the learner.

If printing out the student notes, please note that the photographs should be in colour.

The use of textbooks is only appropriate as an introduction to working with crops.

Activities are identified with the  symbol.

Guidance on Delivery of Crop Production: An Introduction (Agriculture)

It is important that the majority of learning activity takes place using a range of suitable machinery and crops on a working farm. Partnerships with land-based colleges, training providers or employers are likely to provide the most appropriate settings. Students should ideally work with a variety of crops and a range of machinery and through practical work recognise the associated effects of seasonality, in relation to crop production.

It is important that the deployment of appropriate learning environments is preceded by a valid risk assessment by the Centre, particularly identifying any protective clothing and equipment (PPE) that the student may require and any regulations applying to work with plants. Students must be supplied with correctly fitting PPE prior to the undertaking of any of the practical activity.

Centres delivering this learning programme in the context of agriculture should pay particular attention to the risk assessment of sizes of student groups in relation to the number of supervisors available. A maximum group size of 8 students per supervisor is recommended.

Students should gain an understanding about how to prepare fields for a variety of crops and should be actively involved in the primary and secondary stages of cultivation. They should also participate in the sowing or planting of a crop and assist with the aftercare of the crop. Ideally the Centre delivering the award should have access to fields that grow a range of crops to allow the student to broaden their experience.

It would be useful for both Outcomes 1 and 2 to have some classroom theoretical and interactive input prior to undertaking the practical activities.

In relation to Outcome 1 of the Unit:

In relation to preparing and establishing a crop, students should demonstrate safe working practice in relation to working with equipment and machinery. Particular operations will vary according to the crop and growing system. For instance, in relation to barley production it may be limited to helping in relation to selection and setting of machinery, and inspection of operations.

Establishing the crop may include sowing seeds, cultivation, harrowing, slurry application, dung spreading, rolling or lime spreading, depending on the crop. The level of involvement will vary from calibrating machinery and monitoring of machinery, to hands on testing of soil pH depending on the crop and method of establishment. It essential that all students are supervised closely at all times.

In relation to Outcome 2 of the Unit:

This Outcome should be delivered in the context of monitoring and maintaining the health of a crop. Students should, wherever possible, be involved in the harvesting of a crop. The level of assistance will depend on the crop and growing system and will also be affected by seasonal constraints. Students should actively assist in a variety of maintenance operations such as irrigation, fertilising, topping, rolling, slurry application, dung spreading, harvesting of silage, hay, straw and other arable crops.

It is important that throughout practical tasks students are made aware of the importance of safe working practices, and individual responsibility for safe working and adherence to legislation governing health and safety and the use of chemicals, paying particular attention to COSHH Regulations.

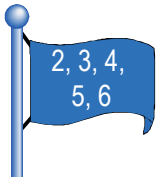
In relation to Outcome 3 of the Unit:

This Outcome covers the knowledge and understanding for a particular crop and should be delivered in a classroom, but should be highlighted at every opportunity during practical sessions.

Students should be taught the basic requirements of crops with reference to soil types and their properties; environmental factors that affect plant growth, such as light, heat, water, seasonality; and identification and control of pests, diseases and physiological disorders.

Students should cover the various stages in crop production ranging from site preparation, establishment, growing on and harvesting.

Employability Skills



Signposting of Employability Skills
in Crop Production (Agriculture)

Throughout the unit students will have the opportunity to develop the following employability skills. This will be chiefly carried out during practical activity but where opportunities arise to integrate and embed these through the class-based activities in this pack, they are highlighted with a numbered flag as shown above. The numbers corresponding to each employability skill are:

1	Timekeeping and attendance	4	Working cooperatively with others	7	Health and safety awareness
2	Understanding roles and responsibilities in the workplace	5	Awareness of efficient resource use	8	Review and self evaluation
3	Planning and preparing for work	6	Following Instructions	9	Positive attitude to learning

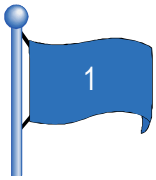
There are opportunities in the Unit to develop all of these skills, particularly if learning activity encompasses the following recommendations.

Integrating the Content of the Employability Skills Unit
and other generic employability skills

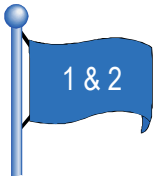
It is important to adopt a delivery approach of emphasising not only the vocational skills development but also the development of employability skills and attitudes in this Unit. This could be done by:

- setting particular start times for practical activities
- monitoring the students' ability to follow instructions
- setting incremental targets for students in terms of mock deadlines for given practical activities (once they have developed reasonable competence)
- monitoring the preparation and planning of the students for practical activities
- setting students a task as a group and allowing them to be responsible for the allocation of subsets of tasks to encourage team working
- encouraging students to reflect on their own and group performance regularly
- monitoring the safety awareness of the learners when carrying out tasks

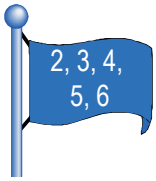
In relation to *Crop Production: An Introduction (Agriculture),* the following examples of learning activity may be appropriate. (Note that some of these activities require the student to have developed some familiarity with the vocational task and the work setting):



- Set a time limit on a task that they have practised such as hitching up a farm trailer.

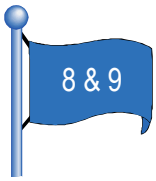


- Set a specific time when students are to be prepared for a given work task, wearing the appropriate PPE and armed with the appropriate tools or aids.



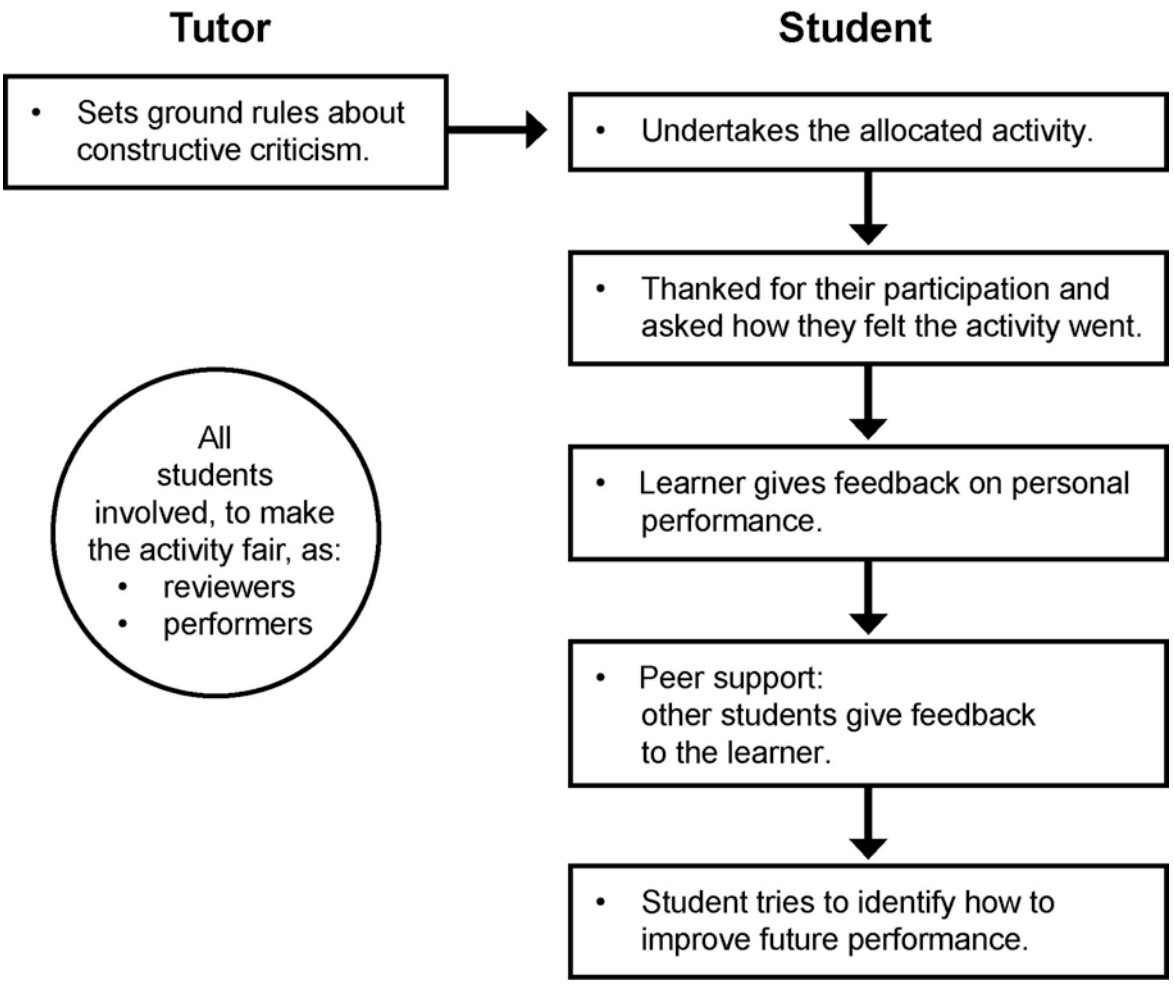
- Instruct a group of students on an overall activity such as fertiliser distribution and allow the group to distribute related activities amongst themselves.

- Students could discuss the hazards for the tasks that they are about to undertake and how they can be minimised.



- Students could be encouraged to participate in self and peer review and evaluation of tasks undertaken.

As much of the activity in this course is practical, group-related and hands-on, it fits well with this simple review model.



Generating Evidence and Assessment Opportunities for *Employability Skills*

In addition to developing the student's employability skills throughout the delivery of the Unit, there are specific opportunities to generate evidence for assessment of employability skills. You should refer to the employability skills profile in the reference section at the front of this pack to familiarise yourself with these skills. You should also familiarise yourself with the National Assessment Bank (NAB) material for the Employability Unit.

There are opportunities to complete all parts the review sheets of the *Employability Skills for Land-based Industries* Unit (Outcomes 1 and 2) when carrying out tasks related to Outcomes 1 and 2 of this Unit establishing and maintaining a selected crop). Note that it would be easier for the activity to relate to all of the self-assessment areas for ease of administration.

- Design the activity in a manner that will make it clear to the students that they have been given the opportunity to demonstrate all of the employability skills by beginning with a short briefing.
- Pay particular attention to the inclusion of *awareness of efficient use of resources*: choose an activity where the student has to, for example, mix up various compost ingredients.

Example

"Today we are going to work in small groups stone picking. You must:

- *form groups*
- *decide what tools/machinery are required*
- *decide who is doing what between yourselves*
- *carry out your part of the activity*
- *tidy up after yourselves*
- *report back to [the tutor] when completed*
- *return to [the classroom] and complete section 1 of the review sheet and bring it to [the tutor] for their section to be completed*

You'll be assisted with tasks when required and you can ask for help whenever you need it."

Students should be briefed, prior to commencement of a planned task, that they will be assessed on the main employability skills identified in the review sheet which are:

- acceptable time keeping and attendance
- understanding roles and responsibilities in the workplace
- planning and preparing for work
- working co-operatively with others
- awareness of efficient resource use
- following instructions
- health and safety awareness
- review and self evaluation
- positive attitude to learning

The students can then be briefed on the second section of the review sheet (strengths, weaknesses and action plan). They should then be asked to complete this prior to the next session planned with the tutor.

Almost all of the practical activities involved in the delivery of this Unit give the student the opportunity to complete the assessment of Outcome 3 of the *Employability for Land-based Industries* Unit.

Carrying out simple risk assessment prior to practical activities is an excellent way to raise student safety awareness of tasks that they are about to undertake as suggested above and could become a regular feature of the delivery of all practical activity in this Unit. This would make the formal assessment activity familiar to the student, allowing several opportunities to complete the pro-forma assessment for Outcome 3 of the Employability Unit.

Resources

Resource Requirements for Crop Production: An Introduction (Agriculture)

Physical Resources:

- classroom or workroom facilities to deliver theory aspects of the course: should include presentation facility, whiteboard or flipcharts
- access to a library and computer suite
- access to a site or sites where arable crops, silage and fodder crops, biomass energy crops or field vegetable crops are grown on a field scale; (this should ideally be a working farm, or land-based college)
- access to a range of farm machinery is an essential part of this Unit

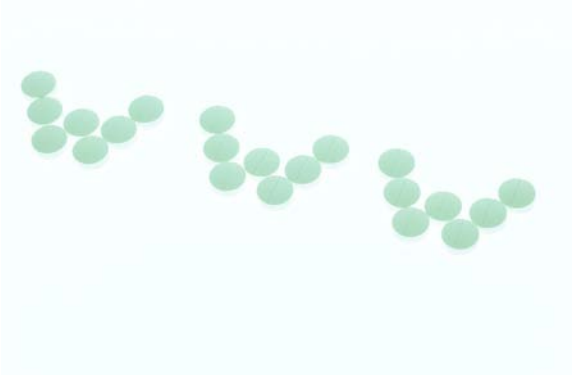
Personal Protective Clothing and Equipment (PPE):

Centres should provide PPE for all students as deemed necessary in accordance with risk assessment of tasks to be undertaken. This is likely to include the following items:

- steel toe-capped Wellingtons or boots
- boiler suit or warm, washable clothing
- waterproof jacket
- gloves

Recommended Supplementary Learning Resources

The following **websites** may provide useful information for both tutor and student reference.



Yara Chemicals http://www.yara.co.uk

HGCA http://www.hgca.com

Scottish Executive: Agriculture http://www.scotland.gov.uk/agriculture

NFU Scotland http://www.nfus.org.uk

Scottish Association of Young Farmers Clubs http://www.sayfc.org

The following **textbooks** also give some good basic information:

Bell, B; *Farm Machinery* – fifth edition; Old Pond Publishing, 2005

Finch, H; *Lockhart and Wiseman's crop husbandry, including grassland*; Woodhead Publishing Ltd, Cambridge, 2002

Hathaway, L; *Tillage: Fundamentals of Machine Operation* – second edition; Illinois: John Deere, 1993

For further explanation consult:

Soffe, J; *Agricultural Notebook* – 20th edition; Blackwell Publishing Ltd, 2002

Suggested Learning Programme
for *Crop Production: An Introduction (Agriculture)*

Chunks of learning activity are suggested for this Unit. The order, grouping and timing of these sessions are at the discretion of individual centres and will depend on factors such as timetabling, class size etc. Classroom activities may be best grouped together and carried out before the practical activity. However, the emphasis is on practical experiential learning and not on didactic delivery of information and most of the allocated time should be dedicated to demonstration of correct practice with the students' involvement in assisting with crop establishment and maintenance.

All practical activities should be preceded by an inspection of students to ensure the correct fitting of PPE.

The following chunks may be appropriate:

- Site preparation: a classroom presentation
- Site preparation using discs
- Site preparation using a sub-soiler
- Soil cultivation using a cultivator
- Soil cultivation using a plough
- Soil cultivation using a harrow
- Soil cultivation using a roller
- Plant nutrition (classroom)
- Classroom session on pests and diseases
- Practical walkabout on weed identification including pressing specimens
- Soil pH (classroom)
- Practical on adjusting soil pH and applying fertiliser
- Soil texture (classroom)
- Soil structure (classroom)
- Practical exercise on determining soil pH
- Practical exercise on fertiliser distribution and calibration
- Practical exercise using dung spreaders/slurry tanker
- Group discussion on hazards associated with tools and machinery and how to minimise the risk of these
- Set practical session for groups to carry out pre-start checks of a piece of machinery
- Group/peer review of evaluating task of carrying out pre-start checks
- Set practical session for groups to carry out pre-start checks given a slightly tighter timeframe
- Group/peer review of performance of carrying out pre-start checks including discussion of how resources could be used efficiently
- Repeat above practical to ensure competence
- Practical session on planting out working out the amount of seed required to sow a field of grass/cereals
- Classroom session on crop types

Practical session on identifying pests, diseases and physiological disorders

Summative assessment session for each Outcome when candidate ready for assessment.

Learning and Teaching with Under 16s

Scotland's Colleges have made significant progress in meeting the needs of young learners. Our knowledge of the learning process has increased significantly and provides a range of strategies and approaches which gives us a clear steer on how lecturers can add to their skill repertoire. Lecturers can, and do, provide a stable learning environment where young students develop a sense of self-respect, learn from appropriate role models and see an opportunity to progress. There are basic enabling skills for practical application which can further develop the learning process for this group of students. So what are the characteristics of effective learning and teaching which will help to engage young learners?

Ten ways to improve the learning process for Under 16s
(This list is not exhaustive!)

1. **Activate prior knowledge and learning** – ascertain what the learner knows already and teach accordingly. Young people do have life experience but it is more limited than adult learners and they may not always be aware of how it will assist them in their current learning.

   Tips - Question and answer; Quick Quiz; Quick diagnostic assessment on computer; present key words from the course or unit and see how many they recognise or know something about.

2. **Tune learners into the Big Picture** – the lecturer knows the curriculum inside out and why each lesson follows a sequence, however the young learner does not have this information and is re-assured by being given the Big Picture.

   Tips – Mind map or concept map; use visuals, for example wall displays of diagrams, photographs, flow charts; explain the learning outcomes in language they will understand; We Are Learning Today (WALT) targets and What I'm Looking For (WILF) targets; give clear and visible success criteria for tasks.

3. **Use Advance Organisers** – these are lists of the key concept words that are part of the course or unit.

   Tip – Highlight on any text the concept words that you will be using; make a visible list and put it on display – concept words can be struck off or referred to as they occur (NB this helps with spelling and independent learning as they do not have to keep checking meaning); highlight essential learning and action points.

4. **Vary the teaching approaches**. The two main approaches are instructing and demonstrating, however try to provide opportunities to facilitate learning.

   Tips – Ask students what they know now that they did not know before, or what they can do now they could not do before, at appropriate points in the lesson or teaching block; ensure there are problem solving activities that can be done individually or in groups; ask students to demonstrate what they have learned; use a range of question and answer techniques that allow participation and dialogue, eg. provide hints and cues so that they can arrive at answers themselves.

5. **Preview and review of learning**. This helps to embed previous learning and listening skills and provides another opportunity to elicit learner understanding. Consolidates and reinforces learning.

   Tips – At the beginning of each lesson, or session, review previous learning and preview what is coming up; at the end of each lesson or session, review what has taken place and what will be focussed on next time – these can both be done through question and answer, quizzes and mind mapping activities.

6. **Language in the learning environment**. Do not assume that the language which is used in the learning environment is always understood by young learners, some words may be familiar but do not have the same meaning when used vocationally.

   Tips - At appropriate points ask students what words mean; explore the various meanings of words to find out if they may have come across this language in another context; by looking at the structure and meaning of words there is an opportunity for dialogue about learning and to build vocabulary.

7. **Giving instructions in the learning environment**. This is one of the most difficult tasks a lecturer has to do whatever the curriculum area. With young learners this may have to be repeated several times.

   Tips – Ask a student to repeat back what you have asked them to do before beginning a task; ask them to explain the task to one of their peers; use the KISS principle – Keep It Short and Simple so that they can absorb and process the information.

8. **Effective feedback**. Feedback is very important for the learner to assess their progress and to see how and what they can improve. Provide opportunities to engage in dialogue about the learning function of assessment – provide details of the learner's strengths and development needs either in written or spoken form. With younger learners identifying one or two areas for development is sufficient along with acknowledgement of what has been done well. Essentially, learners are helped by being given a **specific** explanation of how work can be improved. You can also use summarise assessment formatively, ie. as an opportunity to identify strengths, development needs and how to improve.

   Tips – Ask students themselves to identify their own strengths and development needs – self evaluation; peer evaluation of work can be successful once they have been taught how to do it; the lecturer can produce a piece of work and ask students to assess it anonymously; have a discussion about the success criteria for the task and ensure the students are clear about them; allow learners to set criteria for success and then measure their achievements against these.

9. **Managing the learning behaviour**. Under 16s are coming into Scotland's Colleges and training establishments from largely structured and routine-driven environments in schools and early feedback from those undertaking Skills for Work courses indicates that they very much enjoy the different learning environment that colleges and other training providers offer. Remember though that these are still young learners. They will still expect lecturers to provide structure and routine and will perform best in a calm orderly learning environment. Young students will respond to firm, fair and consistent management. Such routines have to be established quickly and constantly reinforced.

   Tips – Health and safety is non-negotiable and consequences of non-compliance with the regulations should be made clear and adhered to at all times; set out your expectations from day one and provide a consistent message; have clear beginnings, middles and endings for each session; be a positive role model for your students, i.e. be there before they are and manage the learners with respect; always deliver what you promise; build up good relationships and get to know the learners, make the curriculum interesting and stress the relevance of the learning; set up a positive behaviour management system. By following these guidelines you will build up two-way respect, which, while sometimes challenging to achieve, can be very powerful and work to everyone's benefit.

10. **Care and welfare issues**. School/college partnerships mean increasing numbers of young learners in college. Lecturers have to be aware of their professional responsibilities and mindful of young people's rights. However lecturers have rights too, in terms of feeling safe and secure in working with young people and there are basic steps staff can take to minimise risks. It is essential that colleges ensure that lecturers have a working knowledge of the Child Protection policies (local authority and college documentation) and to follow procedures and policies diligently. School/College Liaison Officers will be familiar with these documents and can provide support and advice. There are also training sessions on Child Protection available from SFEU (see below).

    Tips – Avoid one-to-one situations with young students in a closed area; do not do or say anything that could be misinterpreted; if the opportunity arises, do some observation in schools to see and discuss how teachers use the guidelines for their own protection as well as the young person's.

Most young people are a delight to work with and they will positively enjoy the experience of learning in college. However, there will inevitably be some who are disengaged, disaffected and who have not yet had an opportunity to experience success. 'Skills for Work' is a unique educational initiative that young people can be motivated to buy into - you as the lecturer are key to the success of these programmes.

Skills for Work Workshops

To take this 10 point plan forward and to add to it, you can attend one of SFEU's 'Get Skilled Up' half day workshops for lecturers delivering Skills for Work Courses, when we explore further the learning process and look at a range of specific teaching and learning techniques to use with the under 16 age group. To find out when the next event is visit our website www.sfeu.ac.uk or contact the Learning Process team at SFEU on 01786 892000.

Child Protection Workshops

These are run on a regular basis by staff at SFEU in Stirling and also in colleges. For more information on these workshops please contact members of the Access and Inclusion team at www.sfeu.ac.uk or contact the team at SFEU on 01786 892000.

Student Support Section

Welcome to Crop Production (Agriculture)

The notes that you'll be given as you progress through the course are to help you with the background knowledge for the skills that you'll learn whilst on this course. You will find that there are several activities and self-assessment tasks, often followed by some answers.

However you won't be able to pass this unit just by reading these notes and filling in the answers to the questions! This is a practical course where you'll be judged mainly on your practical and employability skills.

If you want to find out more information about working in agriculture there are several web links that you can look at:

Yara Chemicals http://www.yara.co.uk

HGCA http://www.hgca.com

Scottish Executive: Agriculture http://www.scotland.gov.uk/agriculture

NFU Scotland http://www.nfus.org.uk

Scottish Association of Young Farmers Clubs http://www.sayfc.org

However, your tutors are there to support and help you. If you want to find out more- just ask!

A newly sown field in late May

Health and Safety Matters

Health and safety is an important part of everyday life whether at home or work in order to protect individuals and work colleagues.

It's important in this course that, during all activities, you recognise the limits of your abilities and that you ask for help or advice **whenever** you need it – we don't expect you to be Superman or Superwoman!

This unit will mainly be based outdoors and there are a number of Health and Safety codes of practice and guidelines that you need to stick to during any practical sessions.

1. Always wear and make use of the appropriate Personal Protective Equipment (PPE).

2. Always keep your work area tidy and free from obstructions.

3. Act responsibly and don't 'fool around'.

4. Make sure that you fully understand the task that you are about to undertake before you start it. If you are unsure about any part of it……**Ask!**

5. Check tools and equipment before you use them to make sure that they are in good working order.

6. When you have completed a task always remember to tidy up the work site and store all tools and equipment in their appropriate storage areas.
Remember to leave the work area the way that you would like to find it!!!

7. Always identify potential hazards and risks before starting a job. This is called Risk Assessment.

8. It is important that safe lifting and handling techniques are used.

Remember - you need to pay attention and take responsibility for your own safety and the safety of the people working around you.

Crop Production: An Introduction

The most important part of crop production is the preparation of a suitable seedbed for planting and sowing the following crop. If this is not achieved correctly the crop will not **germinate** (start growing) properly and will not be able to achieve its maximum yield potential.

To do this the soil should be cultivated to achieve a suitable **tilth.**

Germination is the process when a seed starts to grow.

Soil with a fine **tilth** has been broken down into loose soil with little or no clods and no areas of compaction.

Preparing the seedbed is important for the following reasons:

- it ensures that the maximum number of seeds will germinate
- it buries and mixes organic matter, e.g. manure, that will supply **nutrients** to the crop.
- it reduces **weed** growth
- it prevents re-growth of crops e.g. grass, fallen cereal seed, etc

Plant Nutrients are plant foods e.g. Nitrogen, Phosphorous and Potassium.

A **Weed** is a plant growing in the wrong situation.

Soils

Have you ever wondered how soils are formed?

Here's the answer!

Soils are formed when the rocks of the earth's surface are broken down by **weathering agents**.

Soils are composed of four basic components:

- minerals from the parent rock
- organic matter
- air
- water

Minerals are formed by the breakdown of rocks. The soil type and level of fertility is governed by the underlying parent rock.

For example, if the parent rock is limestone, it will form a soil that has a high ***pH*** (alkaline).
If the parent rock is granite, it will form a soil that has a low ***pH*** (acid).

The **pH** of the soil tells you whether a soil is acid, alkaline or neutral.

Organic matter is present as a mixture of living, dead and decomposed organisms e.g. farmyard manure.

Air is essential to support plant and soil life.
It is also required for the breakdown of organic matter to release **nutrients** e.g. farmyard manure supplying nitrogen.

Water is essential to support plant and soil life. It is important to have enough water but not too much as this can cause the soil to get water-logged.

The physical quality of the soil is described as its **texture** or **structure** but these two terms mean different things.

Soil Texture refers to the feel of the soil. They are generally classified as sandy, silt or clay soils.

Soil Structure refers to the pattern that the sand, silt and clay particles are joined together. An ideal soil structure should be free draining, hold onto enough water to sustain plant growth and contain adequate air spaces.

Activity

It's possible to determine soil texture by rubbing soil between your finger and thumb. The table below lists the characteristics of the three soils.

Soil Type	Soil Characteristics
Sand	Feels gritty to the touch and it is not possible to roll it into a ball.
Silt	Soil can be formed into a ball and has a silky, soapy feel to it.
Clay	Soil can easily be rolled out into threads. Soil forms a shiny surface when rolled between finger and thumb.

Your tutor will give you some samples to test.

Squeeze a small amount of moist soil between your finger and thumb. Using the descriptions above, can you determine what is the texture of your soil?

	Soil Type
Sample A	
Sample B	
Sample C	

Soils should never be cultivated when they are too wet or frozen as this can damage the soil structure.

The Soil Profile

What is the soil profile?

Answer:

The soil profile refers to the distinct layers of soil that become visible as you dig downwards. These three layers collectively are known as the soil profile.

The upper soil horizon is called **top-soil**.

- This is rich in nutrients and is where the bulk of root growth will be in the soil.
- It is commonly known as the **plough layer** as it is unlikely that ploughing any deeper than this will be needed.
- When cultivating this layer it should never be mixed with sub -soil.

The **sub-soil** lies under the top-soil.

- It contains a lot less organic matter and fewer living organisms than top-soil.
- It is generally a lot lighter in colour.

The lower layer consists of the **parent rock material** e.g. sandstone, granite, limestone.

Typical Soil Profile

Good drainage is essential for all soils and this is achieved by underground drains made from clay pipe or more recently plastic perforated pipes.

Drainage is the removal of excess water from the soil surface to a suitable water outlet.

- Drains are spaced at varying intervals and this will depend on the soil type.
- They should have an outfall for the water to go to and this may be a field margin, a drainage ditch or a watercourse.
- The design of drainage should be such that excess water should flow into the drain from the soil and through it as quickly as possible.
- This prevents water building up which will affect crop growth and delay cultivation.

How to identify a soil with poor drainage:

- Water loving plants such as rushes are present
- Water lying on the surface
- Patchy crop growth
- Shallow root systems

Drainage is important because it:

- allows the soil to warm up quicker in spring
- allows the soil to be cultivated much easier
- prevents clods forming

When you think about this it makes sense.

If you walk over wet soil it will tend to stick together strongly as opposed to walking on dry ground.

The weather is the most influential component of cultivation and this should be considered before, during and after cultivation.

The ideal conditions for cultivating crops are when the soil is dry and not carrying excess water.

- If soil is worked on in waterlogged conditions the soil particles will be compacted into clods that are hard to break down.
- This will mean more time and costs of production will increase.

Properties of soil

Sandy soils	Free draining, easily worked, quick to heat up in spring and requires large amounts of **fertiliser** due to ***Leaching*****.**
Loam soils	Good water and ***nutrient*** holding qualities with a good crumb structure. The ideal soil for the farmer.
Clay soils	Contains a lot of nutrients. The soil is heavy to work and tends to waterlog in winter. In summer it cakes hard and cracks.

Plant Nutrients are plant food e.g. Nitrogen, Phosphorus and Potassium. They are required for strong and healthy growth.

Leaching is the process when nutrients are washed out of the soil due to excess water.

Soil Acidity or Alkalinity

The level of acidity or alkalinity of the soil is measured by the ***pH scale***.

The scale ranges from 1 to 14.

A soil with a pH of 7 is called neutral

Soils with a pH value less than 7 are called acid
The lower the pH value the more acid the soil

Soils with a pH value more than 7 are called alkaline
The higher the pH value greater the more alkaline the soil.

Most UK soils have a pH of between 4 - 9.

The ***pH scale*** measures if a soil is acid, alkaline or neutral.

Activity

pH Scale

Very acidic Acidic Neutral Alkaline Very alkaline

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Decide whether the following soil samples are Acid Alkaline or Neutral:

Sample	*Acid, Alkaline or Neutral?*
Sample 1 has a pH of 13	
Sample 2 has a pH of 1	
Sample 3 has a pH of 5	
Sample 4 has a pH of 7	
Sample 5 has a pH of 9	

Arable crops require a pH of 6 for grassland and 6.5 for cereals.

- To maintain this pH, **lime** is applied to the soil.
- This is generally applied every 5 to 7 years with a proportion of the land being done every year in rotation.
- A typical rate of application would be 4 - 5 tonnes/hectare although the actual amount can vary and is generally tested for, prior to application.
- The majority of lime is applied by specialist contractors

Do not add lime and manure/fertilisers at the same time as the two can react causing a loss of plant foods. There should be a two-month gap between applications.

Activity

Finding out the soil pH

Soil pH can easily be checked using a pH test kit.

It is important that this is done, as some crops require acid soils, some require alkaline soils and some require neutral soils.

Step 1. Take 5 small samples of soil from different parts of the site using a trowel and collect in a bucket.

Step 2. Mix the soil in a bucket using a trowel.

Step 3. Place soil in the bottom of a test tube up to level 1 mark.

Step 4. Add Barium Sulphate to test tube up to level 2.

Step 5. Add pH indicator up to the final level.

Step 6. Add a stopper to the top of tube and shake to mix the contents of tube.

Step 7. Place the tube in a stand and allow to settle.

Step 8. Match the resulting colour with the indicator chart to determine the soil pH.

Write down the soil's pH here _____

Materials Used to Improve the Soil

These are the main types of materials used to improve the soil's texture, structure or nutrient status.

- **organic matter**
- **sand**
- **fertilisers**

Advantages of adding organic matter:

- improves soil structure
- improves drainage
- improves water retention (especially on sandy soils)
- adds nutrients
- encourages worms and bacteria

Sand is added to soils to improve ***drainage*** and make the soil easier to work.
It also increases the depth of rooting into the soil, and allows soil to heat up faster.

> ***Drainage*** is the removal of excess water from the soil surface to a suitable water outlet.

Fertilisers are required by plants to promote balanced and healthy growth.
They are generally applied using a fertiliser distributor (see later section in notes).

Soil Cultivation

Soil cultivation can be carried out using a variety of methods such as rotavating, harrowing and rolling.

Soil should never be overly compacted as this will restrict root growth.

Before any cultivation is carried out it is important that all existing structures and ***services*** are identified. This information should be available from the site plan or your tutor.

Services are things such as water pipes, electric cables, telephone wires and drains.

- It is very important that the soil is worked when it is in the correct condition.
- If ground is cultivated prior to frost the frost action will help break down the clods of soil.

As the soil is the main-stay of all agricultural production it is important to understand and respect the **structure** of the soil and the need to use weather conditions to advantage when cultivating.

Preparing sites for cultivation and planting

Preparing the site involves the removal of any weeds. Also preparation involves stubble (e.g. straw), grass or waste mixing into the soil.

This is generally done using one of the methods below:

- discing
- heavy cultivating
- rotavating

The aim is to break down any debris into small pieces so that it can be easily be buried and mixed in with the soil.

For cereal stubbles it is unlikely that there will be any need for this as the stubble is left short enough to plough in.

Grassland can be grazed down to a minimum height by livestock before cultivating, or destroyed by application of a **herbicide** such as Glyphosate. Once this has been done, the vegetation left can be incorporated into the top 5 - 10 cm using a rotavator.

A **herbicide** is a chemical used to control weeds.

It's also important to remove any large stones after cultivation.

Care should be taken when removing large stones. Where they are too heavy to lift, seek advice from your supervisor.

Before using any piece of machinery it is important that pre-start checks are carried out. To do this you should consult the Operator's Manual. This will tell you what to check, whereabouts it is located on the piece of machinery and how to maintain it.

Before operating machinery always check the following:

- It is correctly attached to the tractor.
- **PTO** guards are in place.
- Blades are not worn or missing
- Oil levels are checked and filled up if necessary
- All points are greased

Particular attention should be paid to the wearing parts of machines.

They are designed to be replaced when they get a certain amount of wear.
If this is not done the machine will not operate to its full potential.

Discs

These are rows of discs angled to cut into the soil and invert and mix the top layer of soil. They can be trailed or mounted on a tractor.

This picture shows the discs working in preparation for further cultivation.

Heavy Cultivators

Heavy Cultivators are made from heavy tines that are attached to a strong frame and have the aim of loosening the whole soil.
The tines are solid and have replaceable wearing points attached to the bottom of them to prevent wear to the tines. These should be checked and changed before any damage can be done to the tines.

Cultivator tine

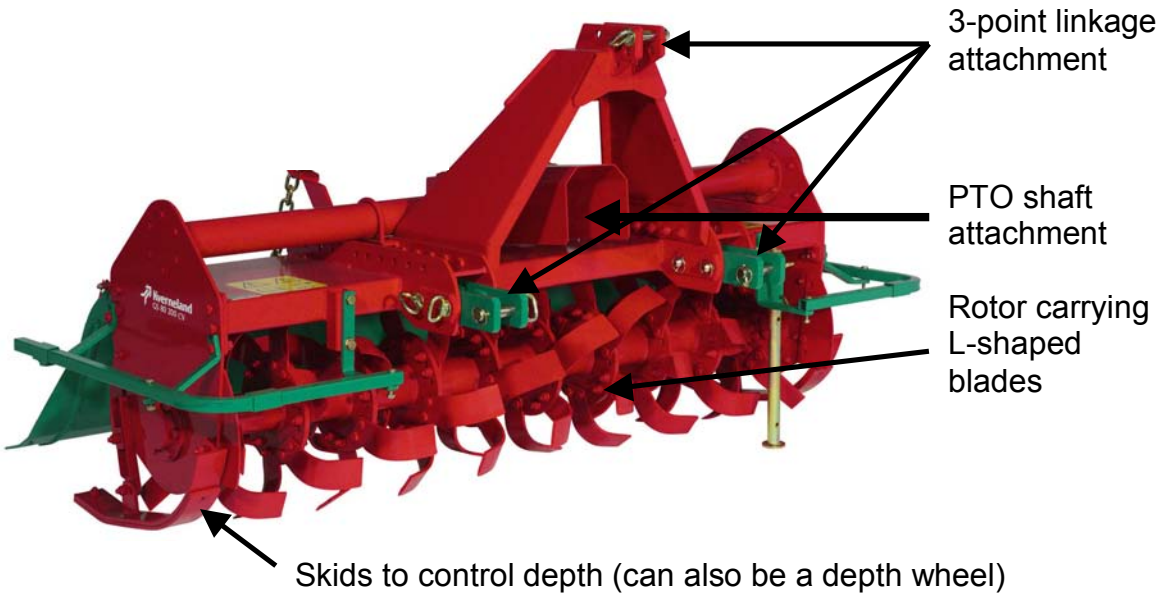
In order to prevent damage from stones or other large obstructions such as tree roots, the tines are often fitted with **shear bolts.** These are bolts that break to allow the tine to be released when they hit an obstruction large enough to cause damage.

Rotary Cultivator

Rotary cultivators are used to mix material into the top layer of soil prior to ploughing.

They are operated from the tractor PTO and are basically a horizontal rotor with L-shaped blades attached to it.

The **tilth** of the soil can be altered by adjusting the forward speed and the speed of the rotors.



There are two stages to cultivation. These are known as **primary cultivation** and **secondary cultivation.**

Once the site has been cleared of any vegetation the next step is to remove any areas of compaction from the soil e.g. gateways, wet areas.

It is important to correct these problems before the main cultivations are carried out, otherwise it will be difficult to identify these areas.

Subsoiler

The job of the subsoiler is to break up any compacted areas that are deep in the soil.

The depth of cultivation will be 30 – 45 cm and should be below the level of ploughing.

Subsoiling should only be carried out when the soil is not excessively wet.

- **Any cultivation in excessively wet conditions is likely to damage the soil structure and cause further drainage problems.**

This picture shows a subsoiler in use and demonstrates the undisturbed nature of the soil after operation.

The depth is controlled by depth wheels situated at the edge of the machine away from tines.

Once this has been carried out the main primary cultivations can be undertaken. For most crops this will mean **ploughing**.

Ploughing

Ploughing is the process of burying weeds and plant growth and turning over the surface layer to a depth of between 20 – 30 cm.

The advantages of this are:

- it prevents re-growth of weeds and seeds
- it mixes existing plant growth with the soil and helps to break it down
- it provides clean ground for the next crop

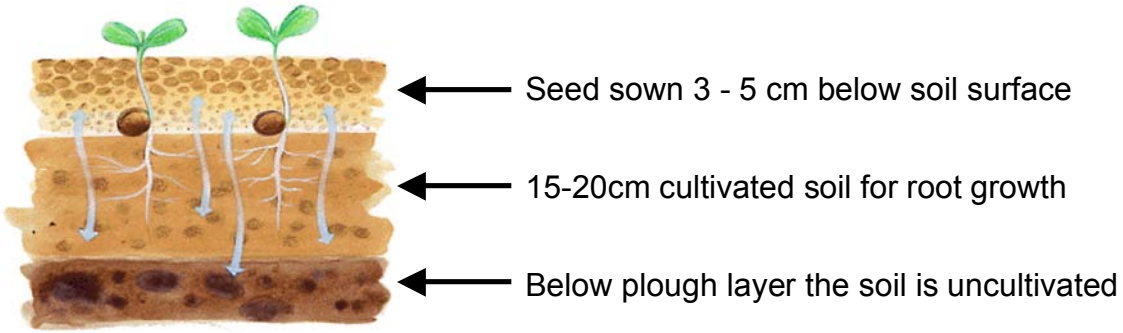
A plough in operation

The next step is **secondary cultivation** to prepare the seedbed for planting.

For cereals, grass and oil seed rape this final cultivation is generally combined with the sowing operation.

The seedbed should be prepared to a **fine tilth** to allow the seed to be planted to the required depth and covered by a fine tilth. The depth of cultivation will vary depending on the crop but for cereals, grass and oil seed rape this will be 10 –15 cm.

The structure of the seedbed should look like this:



Machinery used in secondary cultivation will include cultivators, discs, levelling harrows, rollers and rotavators.

PTO Powered Cultivators

These comprise rotary cultivators (described earlier) and power harrows.

Power Harrow

The power harrow is powered by the tractor PTO and uses rotating tines to move the soil vertically. It has more of a stirring action compared with the rotavator.

Power Harrow

Non-powered Cultivators

These include a wide range of equipment types and often incorporate discs, spring tines, clod bars, and crumblers or rollers.

They are generally wider than PTO-driven machines and are less complicated in their operation. They are most suitable for soils that are easily cultivated and are less prone to forming clods.

Non-powered Cultivator

Rollers

Rollers are used to consolidate ground after ploughing. They also help to break up clods that have been brought to the surface after ploughing.

Cambridge rollers are the most useful as they have a good consolidating and clod breaking effect.

Flat rollers can also be used but have less weight and are more useful after sowing and for grassland rolling.

Cambridge roller

The Cambridge roller pictured above is made up of iron rings that revolve around a central shaft.

Crops

Grass

This includes grass for cutting and grazing. Grass is used for making silage and hay, which are both used for feeding to cattle and sheep.

Barley

Barley includes winter and spring varieties. The main uses are for malting and for animal feeds.

Wheat

Wheat includes winter and spring varieties, with the majority winter sown varieties.

Wheat can be used for animal feeds, distilling and for bread making.

Oats

Oats includes winter and spring varieties with the majority being spring sown.

Uses of oats are for human consumption in cereals, porridge and for animal feeds.

Fertilisers

The application of fertiliser and nutrients is necessary to allow crops to stay healthy and reach their full yield potential.

These can be broken down into inorganic or **organic fertilisers**.

Inorganic fertilisers

- artificial fertiliser
- lime

The main components of fertiliser are **Nitrogen, Phosphorus and Potassium.**

The content of a fertiliser is always expressed as the % of each in the same order, N, P, K.

For example a fertiliser with 20% Nitrogen (N), 10% Phosphate (P_2O_5) and 10% Potassium (K_2O) will be known as a 20-10-10 fertiliser. This is then used to work out how much fertiliser is needed to supply the needs of the crops.

- **When working with fertiliser it is important to ensure that it is handled and stored safely.**
- **Fertiliser should be stored on a level hard surface under cover away from other flammable materials.**
- **Where bags are being handled manually, care should be taken to follow good manual handling techniques.**
- **If forklifts or loaders are being used, this should only be carried out by a competent and trained individual.**

The picture illustrates a range of fertilisers.

The following information is found on a fertiliser label:

- The name of the material
- The nutrient content indicated in numbers, this is generally expressed as the % of N, P and K
- The name and address of the company marketing the material e.g. Yara, Terra
- The weight or volume of fertiliser e.g. 50 kg
- Directions for storage, handling and use

There are 3 major types of fertilisers:

- **Straights** (ammonium nitrate, urea, ammonium sulphate)
  These contain only one major nutrient e.g. Nitrogen
- **Compounds**
  Compounds generally contain all three major elements i.e. N, P, K
- **Blends**
  These are a mixture of different fertiliser types that are blended together each with different levels of N, P and K.

  Blends are cheaper than compounds but can be more inconsistent as they are often not as well size matched. This can often affect the flow rates through a spreader and the spread pattern.

Organic fertiliser

- **Farmyard manure** (a mixture of straw and animal faeces and urine from cattle bedded on straw. This has a solid texture and is commonly seen in heaps or middens. It's also known as dung).
- **Slurry** (from cattle or pigs that are kept on slats or in cubicle houses where the component is faeces and urine. This is a liquid form and is stored in a slurry pit or tank until being spread).

Fertiliser Application

Dung Spreaders

Farmyard manure is applied using a **dung spreader** and is applied at large quantities per hectare.

The side discharge spreader

This spreader is made up of a cylindrical body that is open at one side with an opening lid to allow easy loading by a loader. Inside the spreader there is a rotating shaft that has many chains connected to it.

Slurry Tankers

Slurry tanker

This is used for applying slurry and consists of a large cylindrical tank that is filled using a pump.

During the operation slurry is dispersed through a nozzle at the rear of the tanker.

Fertiliser distributors

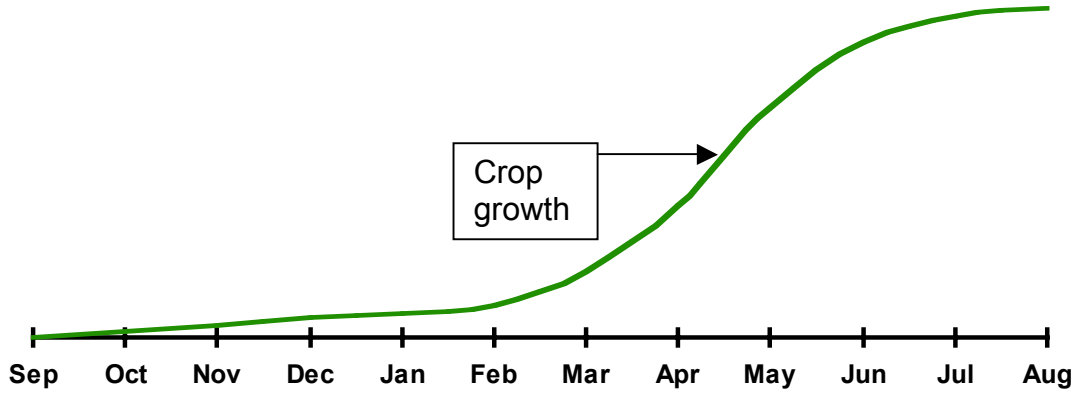
The main types of distributors are **spinning disc distributors**.

These are usually mounted on the tractor 3-point linkage.

They consist of a hopper that has sloping sides to hold the fertiliser and a metering mechanism that allows the fertiliser to flow onto a spinning disc.

By adjusting the size of the opening it is possible to vary the rate of application.

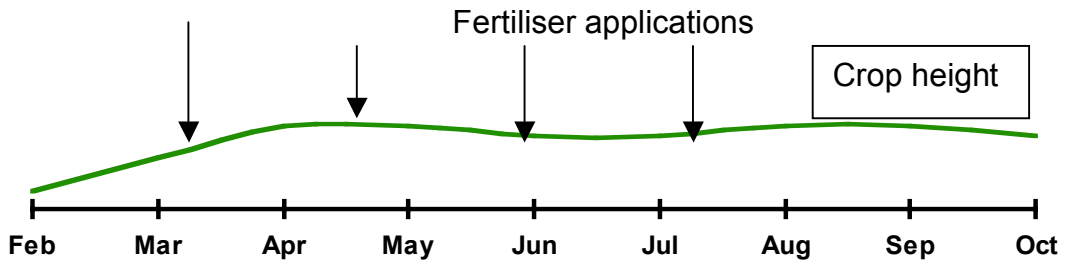
Fertiliser Application timings and Crop Growth



In the graph above, notice that the main application window for nitrogen will be from the period early March to late April.

The usual method is to apply 1/3 of the total at the start of March to coincide with temperatures increasing and the remainder 2 - 3 weeks later.

Fertiliser Application for Grazing Grassland



Activity

Looking at the graph above, when would you apply fertiliser to grazing grassland?

Spinning Disc Spreader

The effects of fertiliser **under** application are:

- reduced yield
- reduced quality
- reduced disease resistance
- increased weed competition

The effects of fertiliser **over** application are:

- excessive growth leading to a reduced yield
- increased disease
- increased costs
- environmental damage

After spreading it is very important to wash out the distributor and leave it in a condition suitable for use.

This is particularly important with artificial fertilisers as they are very corrosive if left on steel without washing for even a short length of time.

Crop Nutrients

The major nutrients that plants and crops use are required in large quantities.

Nitrogen (N)

Phosphorus (P)

Potassium (K)

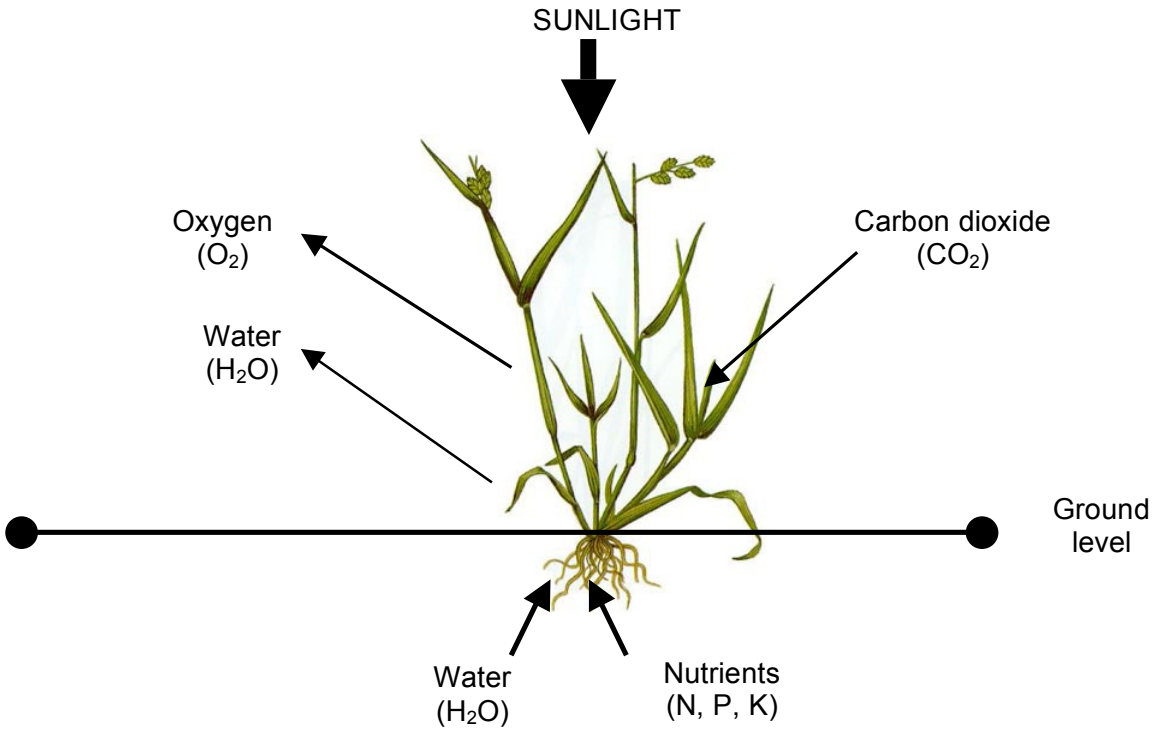
Plants take up nutrients through the roots and use these to grow.

Plants grow new parts using a process called **photosynthesis**.

This is the process by which plants take in carbon dioxide (CO_2) from the atmosphere and water (H_2O) from the soil and convert this to sugars that make up the main plant structure. In this process oxygen (O_2) is released to the atmosphere. Sunlight is required for photosynthesis.

The nutrients needed to support this process are needed in large quantities for crop growth.

Plant Growth



When selecting a fertiliser you need to consider the following:

- method of application
- current nutrient status of the soil
- stage of development
- time of year
- plant species

Plant species require different fertilisers at different times of the year.

The main fertilisers that you will come across are listed in the table below:

Nutrient	***Use in Plant***	***Signs of Shortage***
Nitrogen (N) (applied during spring/summer)	Produces rich green leaves and strong growth	Stunted growth, pale green leaves
Phosphate (P) (applied in spring)	Used to produce strong root system and essential to seeds	Poor root system, small leaves with a purplish tinge
Potassium (K) (applied in autumn)	Used to produce flowering and fruiting	Poor flowering and fruiting and low disease resistance
Calcium (Ca) (ideally applied in autumn)	Used to promote strong growth and change the soil pH	Stunted growth and pale green leaves (similar to Nitrogen)

This is an example of potassium deficiency in wheat showing yellowing of leaf tips.

Activity

You'll get to grips with all the different fertilisers and what they're for, the more you get involved in working in agriculture, but they can be a bit confusing to start with!

Try this activity to check what you remember – go back to your notes if you get really stuck.

1. In the first row, write in the symbol - N, P, K or Ca - for each of these nutrients. In the next row, say when you would apply them.

Potassium	**Nitrogen**	**Calcium**	**Phosphorous/ Phosphate**
Applied in:	Applied in:	Applied in:	Applied in:

2. Now draw arrows to match the nutrients to what they're used for (you'll need to put in the symbol again!):

Nutrient
Nitrogen ( )
Phosphate ( )
Potassium ( )
Calcium ( )

Use in Plant
Used to produce flowering and fruiting
Used to promote strong growth and change the soil pH
Used to produce strong root system and essential to seeds
Produces rich green leaves and strong growth

3. Now draw arrows to match the nutrients to show what happens if the plants don't get enough of each nutrient.

Nutrient
Nitrogen ( )
Phosphate ( )
Potassium ( )
Calcium ( )

Signs of shortage
Poor flowering and fruiting and low disease resistance
Stunted growth, pale green leaves
Stunted growth and pale green leaves
Poor root system, small leaves with a purplish tinge

Lime Spreaders

Tractor-powered

Self-propelled

If the pH moves out of the ideal range from 5.5 to 7 it probably will result in a reduced crop yield.

The main type of lime used is **ground limestone** which is predominantly calcium carbonate. The next most common is **ground magnesium limestone**.

Machinery Used for Maintaining Crops

Grass Topper

A grass topper is a PTO driven implement that can be mounted on the 3-point linkage or trailed behind the tractor.

It consists of one or more blades that cut excessive vegetation off at a set height.

The height of cut is controlled by either wheels or skids that are adjusted to the desired height.

Once the height is set the operator maintains a suitable forward speed to ensure a clean cut and correct overlap. The operator should pay particular attention to stones or other obstructions.

Grass Harrow

Grass harrow

Grass harrows consist of a frame with a mesh of chains attached loosely.

This is specifically for grassland use and helps to break up a matted sward, spread dung out and aerate the surface of the soil.

This allows light into the base of the sward and can help stimulate grass growth.

Diseases, Weeds and Pests

The majority of control measures will involve the application of a **pesticide**.

The application of pesticides is controlled under the Food and Environment Protection Act 1985 **(FEPA)** and this requires that all operators are trained and certificated.

A **pesticide** is a substance that is used to control weeds, diseases or insects.

Common application methods are:

- by tractor mounted crop sprayer
- knapsack sprayer
- **ATV** (all terrain vehicle) mounted sprayer and trailed weed wipers.

Diseases

All crops should be kept healthy to maintain the yield expectations of the crop.

The main threat is from **leaf diseases** that can cause significant yield loss by destroying the green leaf area of the plant. When this is reduced it reduces the plant's ability to photosynthesise and produce enough energy to support crop growth and development.

To protect the plant, it is important to monitor crops regularly for disease and nutrient deficiency and take action accordingly.

On discovery of any irregularity in growth, it is important to notify your supervisor as soon as possible to allow remedial action to be taken.

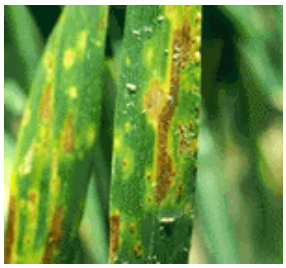
The main fungal diseases are:

- **septoria** (wheat)
- **yellow rust** (wheat)
- **rhynchosporium** (barley)
- **mildew** (grass, barley, wheat and oats)

Fungal diseases can be spread by a range of methods:

- They can be spread by seed, through the air, from leaf to leaf by direct contact, by rain splash and from the soil or residues from previous crops.
- They can attack the crop at any time. They live off the plant and take nutrients from the leaf cells.
- The later the disease is left to be controlled, the more the yield of the crop will be reduced.

Septoria



Septoria is the main leaf disease of wheat and is spread by rain splash.

It favours warm wet weather.

Yellow Rust

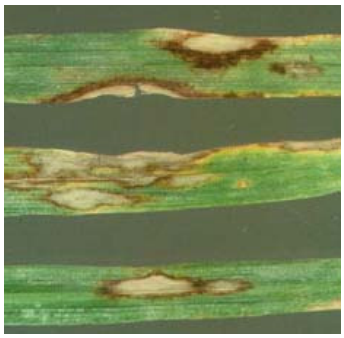
Yellow rust affects wheat and barley and is an airborne disease. It spreads in cool moist conditions in May/June.

Mildew

Mildew affects barley, wheat and oats and is easily identified by the white ***pustules*** seen on the leaf.
It can spread rapidly in warm, dry weather and is an airborne disease.

It is seen mainly from spring onwards

Rynchosporium



Rynchosporium is a serious disease in barley and favours cool wet conditions.

It is airborne and can be very severe particularly in May/June.

Pests

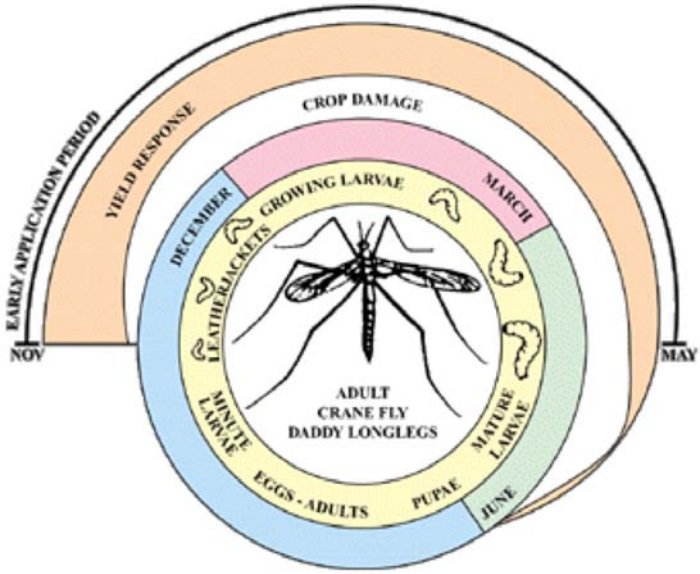
The main groups that affect cereals and grasses are:

Slugs

Slugs favour heavy soil that is cloddy and holds moisture.

They can cause damage to seeds by eating them or by grazing newly emerged seedlings at ground level.

Leatherjackets



Leatherjackets are the larvae of the crane fly (daddy long legs).

They cause damage from November to May by eating the plant's roots.

Their life cycle is shown in the picture.

You can often tell that they're around when you see crows picking at grassland.

With both of these pests the main damage is done to newly sown seeds, and this can cause problems with the establishment of newly sown grassland and cereals.

Symptoms of these will be uneven **germination** of seeds or areas that appear to have been grazed at ground level in small patches.

Rabbits, hares, pigeons, crows and moles

- Fencing, trapping or shooting is necessary to control rabbits whereas the use of scarers is more effective for pigeons and crows.

- With pests such as pigeons and crows, once they have a landing site in a crop they will generally increase in numbers and the damage will increase over this area so it's important to prevent small areas of damage appearing.

- Moles can be trapped or poisoned using baits. This should only be carried out by a competent person who has been trained in the correct methods.

Examples of rabbit grazing damage in cereals

Weeds

An **annual** completes its life cycle in one year

A **biennial** completes its life cycle in two years

A **perennial** lives for three or more years

Chickweed

This is a common weed and is an **annual**.
It tends to spread vigorously and can choke young plants.
It has a pale green colour and appears shiny. Later on it develops white flowers.



Cleavers

An annual weed that can grow over large areas due to its straggly nature.
It is particularly sticky and can climb through and up the crop.
It has distinctive whorls of leaves that grow out from the stem.



Common field speedwell

Common in winter cereals, as it can germinate in autumn and spring.
It has a distinctive blue flower and a hairy appearance.



Mayweed

An upright annual that grows with the crop and competes at all stages.
It is pale green and has a glossy appearance.
Flowers are white with a yellow centre.



Hemp nettle

Also known as day nettle, this is the most troublesome of the nettles.
It is an annual and has an upright growth habit.
Its leaves grow out horizontally and can shade seedlings below.
It can be a particular problem in spring cereals and new grass leys.



Fat-hen

An annual weed that is common in spring crops.
The seeds can also cause contamination with grain and this may lead to harvesting and drying difficulties.
It has a mealy appearance on the leaves and has a distinctive look.



Creeping Thistle

This is a **perennial** weed and regenerates from pieces of root mainly.
It is common to see big banks of creeping thistle and they produce 'thistle down' after flowering.
It has an erect growth habit and has glossy dark green leaves with sharp spines.


Dock

This is a perennial weed and is common in grassland.
It has large shiny leaves that spread horizontally.
It produces tough stems when flowering and this can produce contamination if allowed to grow in cereal crops.



Couch

This is the most problematic perennial grass weed and can be particularly damaging to cereal crops.
It spreads by rhizomes (underground stems) and tends to occur in patches.
It can spread rapidly in light land.
Cultivation breaks it up into smaller pieces and this can lead to its spread as it will regenerate from these.

Ragwort

This is a **biennial** weed which is hazardous to livestock.
During the first year it grows at ground level and appears as a rosette.
It over-winters then flowers during the second year.
It can become more palatable to livestock (particularly horses) if it is cut or treated with a pesticide, so livestock should be removed when this is carried out.

Ragwort rosette stage (1st year)

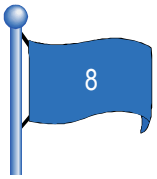
Flowering stage (2nd year)

Wild Oats

Wild oats can remain dormant in the field for many years and can be a particular problem in cereal crops.

They tend to grow in patches and apart from yield loss they can also contaminate seed crops. For this reason they are manually removed in a process called **roguing.**

When removing wild oats it is important to remove the whole plant as smaller stems (tillers) can re-grow and set seed.



Self Assessment

1. What is the ideal pH for growing grass and cereal crops in?

2. What is the difference between organic and inorganic fertilisers?

3. State one symptom of nitrogen deficiency.

4. Why is lime added to the soil?

5. If a fertiliser sack had 20:10:10 listed as the fertiliser content, what percentage of this is nitrogen?

6. What is meant by the term leaching?

7. State two benefits to the soil of adding farmyard manure.

8. What is an herbicide?

9. State two checks that should be carried out prior to operating machinery.

10. What is the purpose of the rotary cultivator?

Answers

1. What is the ideal pH for growing grass and cereal crops in?

   pH 6 - 6.5

2. What is the difference between organic and inorganic fertilisers?

   Inorganic fertilisers are man made, organic fertilisers are naturally occurring

3. State one symptom of nitrogen deficiency.

   Poor growth, light green leaves

4. Why is lime added to the soil?

   To raise the pH and break up clods on clay soils

5. If a fertiliser sack had 20:10:10 listed as the fertiliser content, what percentage of this is nitrogen?

   20%

6. What is meant by the term leaching?

   Leaching is the process where nutrients are washed out of the soil due to excess water.

7. State two benefits to the soil of adding farmyard manure.

   It adds nitrogen; improves soil structure and texture; encourages worms.

8. What is an herbicide?

   An herbicide is a chemical used to control weeds.

9. State two checks that should be carried out prior to operating machinery.

   PTO guards in place, check oil levels, grease nipples, check for worn blades, correctly attached to tractor.

10. What is the purpose of a rotary cultivator?

To mix the material (including weeds) into the top layer prior to ploughing.

Glossary of Terms

ATV	all terrain vehicle
annual	a plant that completes its life cycle in one year
biennial	a plant that completes its life cycle in two years
fertiliser	material or liquid added to the soil to supply nutrients
fine tilth	soil with particles that are fine and easily worked
germination	the process when a seed starts to grow
herbicide	a chemical that kills a plant
inorganic fertiliser	man-made fertiliser
leaching	the process where nutrients are washed out of the soil due to excess water
organic fertiliser	fertiliser made from natural matter
pesticide	a substance that is used to control weeds, diseases or insects
perennial	a plant that lives for three or more years
pH	the ***pH scale*** measures if a soil is acid, alkaline or neutral
photosynthesis	process by which plants take in carbon dioxide (CO_2) from the atmosphere and water (H_2O) from the soil and convert this to sugars that make up the main plant structure
plant nutrients	plant food e.g. Nitrogen, Phosphorous and Potassium
PTO	Power Take-Off: a part on the rear of the tractor that allows power to be transferred to other machinery e.g. rotavator
pustules	small raised spots or swelling on a plant resulting from fungal infection
roguing	removal of inferior or defective plants or seedlings from a crop

rotary cultivator	(rotavator) a machine with rotating blades for breaking up or tilling the soil
sub-soil	the layer of soil under the top–soil
top soil	the upper layer of soil, also known as the **plough layer**