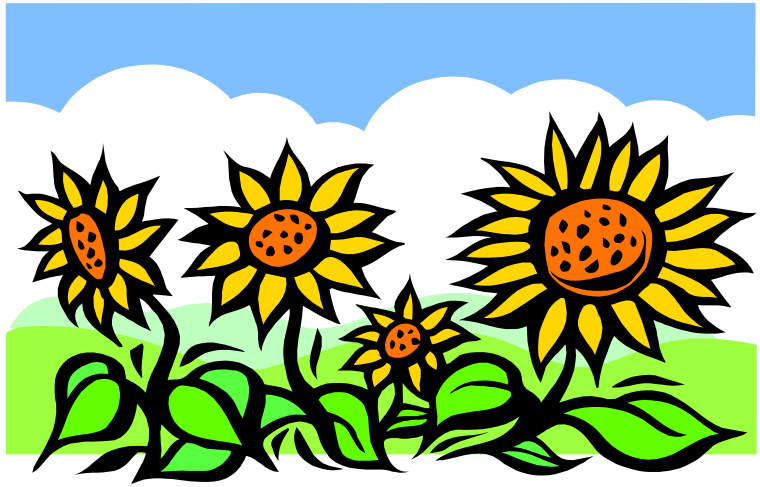
ТАВРІЙСЬКА ДЕРЖАВНА АГРОТЕХНІЧНА АКАДЕМІЯ

КАФЕДРА ІНОЗЕМНИХ МОВ
Англійська мова

НАВЧАЛЬНИЙ ПОСІБНИК
З АНГЛІЙСЬКОЇ МОВИ
ДЛЯ СТУДЕНТІВ ТА МАГІСТРАНТІВ
ВИЩИХ НАВЧАЛЬНИХ ЗАКЛАДІВ
АГРАРНОГО ПРОФІЛЮ
ЗА СПЕЦІАЛЬНІСТЮ «АГРОНОМІЯ»

READINGS ON AGRONOMY



Мелітополь
2005

Упорядник: викладач С.П. Шевченко

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Навчальний посібник з англійської мови для студентів та магістрантів вищих навчальних закладів аграрного профілю схвалено на засіданні кафедри іноземних мов ТДАТА.

Протокол № ___від "___" _____ 2005 р.

Посібник затверджено на засіданні методичної комісії факультету ПЗПСГ.

Протокол № ___від "__" _____ 2005 р.

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ПЕРЕДМОВА

Навчальний посібник з англійської мови “Reading on agronomy” розраховано для студентів та магістрантів вищих навчальних закладів аграрного профілю за спеціальністю ”Агрономія”.

Ціль посібника – навчити студентів читати та перекладати тексти, вести бесіду за спеціальністю. Посібник складається з семи розділів. Кожний розділ містить оригінальні матеріали з наукових статей, підручників, сторінок Інтернету за питаннями біології та агрономії. Тематика розділів посібника допоможе студентам дізнатися, що таке сівооборот, як правильно організовувати теплиці та парники. Які існують особливості культивації тієї чи іншої культури. Якими хворобами можуть хворіти сільськогосподарські культури та як треба боротися з цими хворобами, які комахи шкодять зросту та розвитку культур та засоби боротьби з цими шкідниками.

Після текстового матеріалу кожний з перших шести розділів пропонує студентам виконати ряд вправ та завдань, які виявляють вміння студента здобувати інформацію з прочитаних текстів та допомагають повторити та закріпити опрацьований матеріал.

Сьомий розділ містить тексти для перекладу та анотування.

Після розділів міститься тлумачний словник основних агрономічних термінів.

Довідковий розділ та словник посібника полегшують засвоєння матеріалу, що надається розділами.

Unit 1

In this unit you will find the answers for the following questions:

- Are plants important for mankind?
- How can we use plants?
- How to select a particular crop and variety to grow?
- What types of soil are there?
- How to add lime to the soil?
- What is the value of humus?
- What kinds of soil tools and equipment are there?

Crop industry

Plants are autotrophic organisms, forming the base of all food chains. They are important not only for food but also in maintaining the oxygen levels of our atmosphere as a byproduct of photosynthesis.

Plants provide all of our food through the products they produce, either directly as plant products (as in grains, fruits, and vegetables), or indirectly through animal products (meat, milk, eggs).

Plants also contribute to our quality of life through shaping our environment as natural vegetation or ornamental species, through making play areas more enjoyable (turf), and recreation activities (gardening).

Plants provide us with such things as: food, fossil fuels, medicines, building shelters, fibres, beverages, perfumes, dyes, spices, soaps.

Crop plants are any plants grown for economic reasons. This involves any part of a plant; seeds, roots and tubers, leaves, fruit, stems, and sap. Agriculture uses plants to produce food, fibre, or recreational opportunities.

Crop Selection

In order to select a particular crop and variety to grow, many factors must be considered. Selection is hardly a simple process, and involves experience, current information, and maybe a bit of luck.

Plant types should be:

- suited to the climate of a particular area,
- resistant to disease or plant pests in the region,
- appropriate to the rotation sequence for the field,
- suitable to the producers needs, equipment, and time schedule,
- and matched to the market demand at the time (if it is to be sold as a cash crop).

A general key to determine climate suitability of certain crops and varieties is the days required for a plant to mature or "Days To Maturity". The DTM is the time interval between seeding and crop maturity (ready to be swathed).

The average (and lowest) number of frost-free days for a particular crop production area, along with knowledge of the type of spring in a particular growing season are strong indicators of the type of crops able to be grown. A wet, late, and perhaps cool spring in areas would encourage selection of varieties or crops which require fewer days to maturity (maybe varieties of barley or Polish canola).

Expected yields are a concern to any farmer. Producers must weigh a loss in yield against a gain in quality, or hardiness (or vice versa) in order to get the most benefit from their land. In order to accomplish this, producers must know the specific conditions of their growing area, their market demands, and their own goals in order to make appropriate decisions.

Time taken to analyze a particular situation is time well spent for a producer, allowing him or her flexibility and profitability; knowing is half the battle.

Preparing the soil.

It is most unusual to find a plot, where the soil is in exactly the right condition to grow top quality crops. Sometimes it is too heavy, and badly drained, so that surplus water is left around the roots of the plants in winter which will cause them to decay. On the other hand if the soil is sandy, it is quite likely that during the summer months it will be unable to hold the amount of water that the crops need to make vigorous growth. Some soils lack lime, others have too much of it; both these conditions must be corrected.

Soil Testing

As a general rule, soils can be divided into four main groups. There is clay, containing about one third clay particles; rich loam, which has no more than one fifth clay particles; light, of which about three-quarters is sand; and calcareous, which has a very high chalk or lime content. The first requirement is to discover the pH value: this is the hydrogen ion concentration of moisture in the soil, which is responsible for the degree of acidity or alkalinity.

The home kit consists of a bottle of indicator solution; a quantity of barium sulphate; some distilled water; glass test tubes; and a coloured chart. Take small quantities of soil from five or six different places and mix them in a bucket to give an average reading; there can be quite wide variations in pH in even quite a small plot. If the soil to be tested is wet, let it dry out a bit; a crumbly texture is best. Fill an upright test tube half way to the top with some of the soil, add a small amount of barium sulphate, then fill it almost to the top with distilled water and add a few drops of the indicator. Put a rubber stopper on the end of the tube, shake up the contents and allow them to settle, and then compare the colour to those on the chart.

Where the soil shows a lime deficiency, treat it with 3kg of hydrated lime per 9sq m of ground for each hydrogen ion value. Most crops prefer well limed earth in winter.

Types of Soil

Clay These drain badly because the particles are too heavy to let water through. In extreme cases, where water lies on the surface in puddles, it may be necessary to lay land drains. Normally adding coarse sand is sufficient, and equal quantities of peat or compost by bulk. Five to eight centimeters of this mixture dig into the top 25cm should give a soil which can be worked comfortably. If you repeat this treatment every year, a very good loam soil will result. Add some humus every year to prevent the soil returning to its heavy clay state.

Sandy soils The problem here is that the soil drains too fast, and the answer is to dig in as much water retaining material as possible. Peat, leaf-mould, compost

or manure should be dug in every year — 8 to 15cm at first, less as the soil begins to improve.

Loam It is lucky to have a good loam soil - do not let it deteriorate. 5cm of humus each year will replace the goodness that has been taken out of it.

Subsoils The top layer of the earth is topsoil. If you start to dig down, it will begin to change colour, and this area is called the subsoil. This should not be disturbed, and if it has to be, keep it separate from the topsoil. If you do not have a sufficient depth of topsoil to grow all the crops that you want — 20cm is usually adequate — it can only be built up slowly: a further 5cm dug in each year, turning up 5cm of subsoil at the same time. Do not try to convert a greater amount of the subsoil in one season, because it simply cannot be done.

Hardpan This is a completely hard subsoil, and the water will be quite unable to drain through it. To drain the land, you must dig a hole through the hardpan in a non-growing area. It will be necessary to use a pickaxe, and you will know when you are through the hardpan because the digging will get noticeably easier. The hole should be 1 to $1^{1}/_{4}$ m in diameter and may need to be $2\ ^{1}/_{2}$ m deep.

When you have dug the hole, fill it with rubble and broken bricks. Then lay the land drains in a herring bone pattern, the spine of the herring bone emptying into the hole, which is known as a soak away. The drains should be packed around with pebbles, and be at least 20cm under the surface of the soil, and should have a fall of at least one in sixty. Once the drains are in place, they should last at least ten years, and very likely will survive for twenty.

Adding Lime to the Soil

Apart from its ability to correct the acidity of soil, lime has the power to release the various plant foods already in the soil, and also to improve the physical condition of the soil by breaking up the clay particles. On a very heavy soil caustic (unhydrated) lime will be of more use than hydrated lime. It is obtainable from builders' merchants and it must be kept dry. It is dug in when the soil is dry, and is activated by such moisture as there is in the ground. Without lime, a heavy soil will become still heavier in the winter rains, and so deprive the plant roots of the oxygen they need.

Lime has a tendency to be washed down by rain, and where it is used in hydrated form it should be applied to the surface in mid-winter after the ground has been dug and the surface left in a rough condition, to be broken down by wind and frost.

Soil may also be tested for nitrogen, potash and phosphorus deficiencies so that the correct requirements of each individual crop can be supplied in the right amounts. If nitrogen is lacking, the plants will have their growth stunted, and will look sickly; if there is not enough potash, there will be a lot of soft lush growth which is very weak and will not stand cold or resist disease, and if there is not enough phosphorus the plant roots will not be able to develop properly.

To correct a nitrogen deficiency, give a 120 per sq m dressing with sulphate of ammonia for every 1% deficiency. To ensure the correct phosphate content, the ground should be given a dressing of superphosphate of lime at a rate of 100kg per sqm; and to correct a potash deficiency, give a dressing of sulphate of potash at a rate of 60g per sq m.

If the soil shows a deficiency of each of these plant foods, a compound fertilizer may be made up to the exact requirements, and applied in spring before the crops are planted. Soil testing can be done on the spot with a special kit, but as with the pH test, check various areas of the plot as not all may have the same deficiency.

The Value of Humus

Humus may take the form of decayed leaves or straw that have been broken down (composted) by an activator. Peat is also useful, but as it is slightly acid, lime should be added as well. Peat can be used to improve all types of soil and has a very beneficial action on roots, allowing them to grow unrestricted. Sphagnum moss peats are those which are only partly decomposed, and these are useful where it is necessary to retain moisture. Other valuable sources of plant foods are: for those living near the coast, seaweed (chopped) has traces of nitrogen and potash; and in the industrial parts of the country, wool shoddy is rich in nitrogen. Used hops and spent mushroom compost are usually available to those living in the country, and these both have a variety of plant foods. Straw composted with an activator also provides both humus and nutrients.

To compost straw, get a bale and shake it out well in a corner of the plot, preferably where it can be surrounded with boards or corrugated iron sheeting. This will not only keep it tidy but will protect it from drying winds so that the straw can be more quickly composted. As the straw is spread out, soak it with water then spread a layer 30cm deep and sprinkle some of the chemical activator over it. Keep doing this until the heap has been built up to about 1½m, It will soon begin to heat up and in ten days will be ready to turn, shaking out the straw and activator, giving more water if necessary, and remaking the heap. Allow it to heat up for a further ten days before repeating the process, and in three weeks the straw will have become dark brown and the bits will be quite short and will be easy to dig into the ground.

The ultimate aim with any soil is to bring it to a fine tilth, deeply enriched with moisture holding humus, active in bacteria, and spongy and friable when you press it in your hands. It will be well drained but also able to hold moisture, and will be ready to work in all weathers other than snow and ice. It will also warm up with the first spring sunshine so that your plants will get away to an early start.

Preparing the Ground

When we first make the decision to grow vegetables, for example it will be necessary to wait until the autumn to make a proper start. If the space is not being used for anything else, we can cultivate quick-growing salad crops, and maybe carrots and spinach; but a proper vegetable growing cycle must be started in the autumn.

Start to dig the soil before hard frosts set in; the ground must be cleared, especially of perennial weeds, and the lime content increased if this is necessary.

If the land has not been deeply worked in the past, it is best to double dig. The area should be marked out into sections of one sq m and soil to a depth of two spades should be taken from the section at one end and carried to the far end. Soil from the next section to two spade's depth is moved into the first, now empty, trench, and so on, until the earth from the original trench is used to fill the trench at the far end. Add humus and

fertilizers as the digging proceeds, and leave the surface rough so that the winter frosts can break it down.

The process of double digging is invaluable because it allows the air to circulate freely through the earth to a considerable depth, but when the spring comes, especially if there has been heavy rain during the winter, it will be necessary to break up the surface with a hoe, which will also help to keep down annual weeds.

Mulching between the rows also helps to keep down weeds; in addition this enriches the soil below as the organic material is carried down by rain and worms.

Table1: Fertilizers and their food value.

FERTILIZER	ACTION	NITROGEN CONTENT	PHOSPHATIC CONTENT	POTASH CONTENT
Basic Slag	Slow	15%		
Bone Meal	Slow	5%	20%	
Dried Blood	Medium	10%		
Farmyard Manure	Slow	5%	25%	5%
Fish Meal	Quick	10%	8%	7%
Guano	Quick	15%	10%	7%
Kainite	Slow			13%
Nitrate of Soda	Quick	16%		
Nitro-Chalk	Quick	16%		
Potassium Nitrate	Quick	14%		40%
Poultry Manure	Medium	3%	2%	6%
Rape Meal	Slow	5%	2%	1%
Seaweed	Slow	5%		1-5%
Shoddy (Wool)	Slow	12%		
Sulphate of Ammonia	Quick	20%		
Sulphate of Potash	Medium			50%
Superphosphate	Medium		15%	
Used Hops	Slow	4%	2%	

Soil Tools and Equipment.

Modern tools have two great advantages over their predecessors – their lightness, and the ease with which they can be cleaned. Do not think however that because the tools are made of stainless steel that they need not be cleaned regularly – wipe them clean with a rag when you have finished with them for the day, and it is worth while giving them an occasional wipe with an oily cloth if they are to continue to give good service for many years to come.

Here are some soil tools and equipment. Read and remember their uses.

Rotator – for soil cultivation.

Fork – for pricking the surface forking in peat and fertilizers, and for lifting crops such as potatoes, parsnips and leeks. Spade – for turning over the soil an autumn and for turning over the compost heap, for digging the plot initially if this is necessary.

Rake – for getting out weeds and stones after the digging has been done for raking seed beds to a fine tilt, and for taking out drills and covering them after sowing.

Hoe - for hoeing between the rows to keep weeds down and for hoeing between the plants which will control weeds and also loosen the soil and thus aerate the roots.
Trowel - for planting out seedlings.
Dibber – for planting out leeks and lettuces.
Wheelbarrow - for throwing spadefuls of waste matter accurately on to the compost heap or bonfire.
Pick – for getting through hard land which has not been cultivated before, or not for a long time.
Spirit level – for making level paths, or checking the levels of existing paths, or for making sure that the foundations for a greenhouse are correct.
Fertilizer distributor – for distributing different kinds of fertilizers.
Seed driller – for ensuring even planting.

Questions and tasks for comprehension.

1. What kind of organisms are the plants?
2. Why do we use plants?
3. What should we take on account selecting a crop?
4. What type of soil is the best for cultivation? Why?
5. What types of soil prevail in your region?
6. Why lime is so important for the soil?
7. Why is humus so valuable?
8. What kinds of soil tools and equipment are in common uses?
9. What kinds of tools or equipment do we use for sowing crops?

Task 1. Study Table 1. Say what kinds of fertilizers are the most and the least valuable food for plants.

Task 2. Complete the following sentences.
Lack of lime in the soil can lead to …
Lime in the soil can …

Task 3. Sum up:

1. Give instructions for soil testing.

Compare types of soil.

Unit 2

In this unit you will find the answers for the following questions:

- What is rotation?
- What is three and four year rotation?
- What is a frame?
- What kinds of greenhouses are there?
- Why do we like to cook with herbs?

Rotation

Rotational cropping should be practiced in even the smallest vegetable garden. This will help prevent the pests and diseases which attack one particular group of plants from building up in the soil. In some cases this build up can only be reduced; if you are unfortunate enough to have club root in your soil, this fungus can live for twenty years in the ground which is more than any rotational system can eradicate.

If you practice rotation, a balance will be maintained between the various plant foods, and the soil will be less likely to build up an adverse reaction to any particular plant. As well as this, the different methods of cultivation followed for each plant will make certain that the soil is well dug and properly treated to a considerable depth, and this will all help to restore and maintain a healthy balance. The soil will be opened up and aerated, the bacteria will be able to obtain the supplies of oxygen which they need to convert the fertilizers and manure which the gardener will add into a form in which the plants can absorb them.

Making the Most of the Soil

The correct rotation of cropping will bring about the most economical use of the vegetable plot because one will need fewer fertilizers. As an example, cabbages and cauliflowers take large amounts of nitrates from the soil, while the legumes (peas and beans) return nitrogen to the soil — their roots have nodules which 'fix' the nitrogen in the earth. The brassicas (cabbages, cauliflowers, sprouts, broccoli, kale) should therefore follow the peas and beans. Salads can be grown as 'catch crops' in any of the sections.

To keep the soil in good condition you must ensure that it does not have a deficiency of lime, but whereas some crops require large quantities of lime, others such as potatoes do best in a slightly acid soil. If there is not enough lime, the inert plant foods stored in the soil will not be able to be released for the growing crops to take up and all the manure or garden compost that you may possibly add will be of little use. Rotation helps constantly to correct the various imbalances.

Four Year Rotation

If there is enough space, it is better to follow a four year rotational plan rather than a three year one, and if you are going to grow main crop potatoes, a four year plan is really essential. If your plot is being cultivated for the first time, a potato crop will be of great value: they clear the ground in a way that no other crop can equal,

and by moving them around the vegetable garden, the plot will be kept reasonably free of weeds.

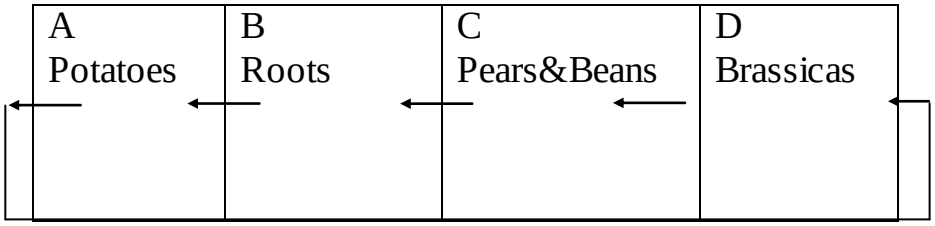
When planting the potatoes, manure the ground first. A heavy application of manure given to the potatoes will mean that only quite small quantities will need to be given to the following crops during the next three years before that particular patch of land is used for potatoes again. Follow the potatoes with root crops: these need a well-limed soil, and always do best in one which has been manured for a previous crop. If they are sown in freshly manured ground, this causes the roots to grow forked, and their keeping quality will also be reduced. Follow the root crops with legumes, which will increase the nitrogen content of the soil, and this will benefit the fourth and final crop from the plot, the brassicas.

Then start all over again, manuring that site heavily for the potatoes.

Three Year Rotation

There is room in a three year plan for early potatoes, but not really for maincrop ones. The early potatoes can be grown with beetroots, carrots, parsnips, radishes, swedes and turnips, but the site must not be manured. The peas and beans and leeks will follow them on the site, and then the brassicas.

Table 2: *Four-year rotation*



There are three year rotation which go the same way except that potatoes will not be included.

Frames and Greenhouses

Frames

The simplest type of frame consists of four pieces of wood, a low one at the front, a tall one at the back, and two sloping sides. On top of this is placed a large glass window, hinged to the back of the frame, and known as a light. The light is opened from the front, and should be arranged so that it can be propped open in varying positions. This way one can harden off the seedlings, or fully ventilate studier plants. Traditionally, plants with frames are grown in the ground. The slope of the frame should face south, to trap maximum sunlight and warmth. A frame enables you to sow seeds two or three weeks earlier than can be done outdoors in your area, and will enable crops to grow on for the same amount of time after the first frost.

Light To get maximum sunlight penetration, the glass should be at right angles to the sun's rays. Unless you lived on the equator, the sun's rays will not strike the glass at the same angle all the year round; so probably the best idea is to set the glass to gain maximum benefit from winter sunlight, on the grounds that there will be sufficient light in late spring and summer anyway.

Heat If you want to use your frame to the utmost, you can put soil-warming cables inside it buried in a layer of grit under the growing mix. Soil temperature can then be controlled with a thermostat linked to a thermometer set in the soil. Simpler ideas include covering the frame with an old rug or coconut matting to conserve heat on frosty winter nights, putting an additional sheet of glass on top to provide double glazing. Plastic netting will break the force of strong winds when the frame is open, and will also keep birds, cats, and other small animals away. If two frames are built back to back, this will provide a mini-greenhouse.

It is possible to buy lightweight aluminium frames which can be moved around easily; these are effectively large scale cloches, and can be moved around the vegetable patch to help along whichever crop is needed next.

Greenhouses

A greenhouse ameliorates the extremer effects of the weather, and is of great benefit in enabling the amateur gardener to grow unusual vegetables, or to get the more ordinary crops that much earlier. There are basically four sorts of greenhouse to choose from, classified according to the minimum temperatures at which they are maintained.

Cold These are heated by the sun only. This restricts the house's usefulness to the spring, summer and autumn, and success will be greatest in spots which are naturally sheltered.

Cool These are suitable in terms of running costs and efficiency for a very large number of gardeners. They are not heated in summer, but warmed artificially from autumn to spring to keep the temperature at about 7°C. They are frost free, and can be used for overwintering many vegetables and herbs. During the summer they can be used for tomatoes, aubergines and sweet peppers, which are not always sure to do well out of doors.

Intermediate or warm In these the temperature never falls below 13°C. This means that tomatoes, cucumbers, lettuces and so on can be raised in both winter and summer.

Stove or hot These are most unlikely to be of any benefit to the vegetable grower, with temperatures having to be maintained at a minimum of 18°C. Leave these to those gardeners specializing in orchids, palms and exotic fruits.

Greenhouses are often classified according to the shapes of their roofs.

Span-roofed houses The most popular kind, these are tent-shaped and have sides which are either vertical or slightly sloping. The roof rises to a ridge in the centre. The angle of the roof varies widely between different models. If you live in an area with heavy winter snowfalls, choose a more sloping roof; this will minimize the risk of damage, especially in an unheated house. The greenhouse glass can come right down to the level of the foundations, or there may be walls from a height of two bricks to half the total height made either of bricks or of composition blocks. Some greenhouses come with prepared bases of metal, wood or asbestos. A compromise can be a half wall on one side, and a glass wall on the other, usually the south, side.

Gutters or eaves traverse the span-roofed house at between 120 and 180cm, while the ridge itself is usually half as high again. The roof should have at least one ventilator.

Lean-to greenhouses These have been unpopular in the past due to the difficulty of ventilating them properly, but they are more favourably regarded now as they take up little space, are convenient to use, and can be heated directly from the domestic heating circuit. It is possible to buy fans to solve the ventilation difficulties, and they can turn out to be a very successful enterprise, especially where they face south.

The roof of the lean-to can either be a single slope or a threequarter pitch with a ridge. If you cannot afford extractor fans, make sure that the ventilators on sides and front of any lean-to give a good through current of air.

Dutch light houses These consist of single sheets of glass, each framed lightly in wood and measuring 150 by 75cm, which are then bracketed together by their grooved sides. The gable ends are hinged so that they can be lifted to make room for a tall crop. They are popular with commercial lettuce and tomato growers, but for the amateur, their composition means a large heat loss from between the frames. They are however comparatively cheap to buy and easy to put up.

The low roof tends to restrict head and working room, but the whole structure could be mounted on a brick base wall to add height.

Curvilinear or Mansard houses These allow very large amounts of light to enter and make ideal all-purpose greenhouses. It tends to be more suitable for propagation and perhaps pot plants than for vegetables however.

Circular houses These have only comparatively recently become available, but are rapidly growing in popularity. Air conditioning or extractor fans must be used to prevent overheating in summer.

Plastic greenhouses These are made of 500 or 1000 gauge polythene or PVC with rigid plastic supports, and are cheap and simple to construct, although they do have disadvantages. A greenhouse made of one of these materials will probably only have a life of two years, as eventually the ultra-violet rays from the sun will weaken the material, and it may get torn by the wind. Another disadvantage is that the plastic quickly becomes cloudy and dirty, because dust clings to it very tightly. Although it can transmit light efficiently, it will not, unlike a glass one, trap heat from the soil and from metal fittings, so that it will cool down very quickly. PVC is better in this respect than polythene.

Inside a plastic greenhouse, ventilation by fan is necessary to cut down condensation. The greenhouse needs to be anchored firmly, and crops growing against the walls will need extra support.

Whatever their design, all greenhouses should be stable enough to withstand strong winds and constructed so that the panes of glass do not vibrate and shatter. When choosing a model, make sure that the door is conveniently placed and wide enough to take a wheelbarrow, and that it opens inwards or slides sideways.

Selecting a site

The success of your greenhouse will depend a great deal on where you put it, for a convenient spot in the garden will be useless if it gets no sun. Remember to take into

account the shade cast by trees if you are putting up your greenhouse in winter time after the leaves have fallen.

A sheltered position in sun is ideal; make sure that the edge is at least 3m from any hedge, so that there will be no interference from roots; and consider the ease with which water and electricity supplies can be brought into the greenhouse when choosing the best spot in your garden to site it.

The Herbs

Most people think of herbs as a specific type of plant, which is to be added to cooking to enhance the flavour or give a completely different taste. However, any herbaceous or woody plant which is aromatic in one or more of its parts, and which is considered to have culinary, medicinal or cosmetic value can be called a herb.

One of the most satisfying ways to grow herbs is to enclose them in their own garden within the main garden. Nearly all kinds like full sun, well cultivated soil, and a certain amount of shelter.

Dill *Anethum graveolens*

This is a hardy annual growing to 90cm tall, with a spread of 30cm. It is not unlike fennel in appearance, with very finely divided fern-like leaves and a thick stem. It bears small, dull yellow flowers from June to August. Seed should be sown outdoors in March or April in a moist but well-drained soil, and in a sunny position. Germination takes two to three weeks depending on the soil temperature. Rows should be 30cm apart, and the seedlings should be thinned to 23cm in the rows. It does not transplant well. July sowings can also be made for autumn use. Keep the plants well watered to prevent premature flowering.

The leaves are used for flavouring salads, fish and vegetables; the seeds taste unpleasant but can aid digestion and also act as a mild soporific.

Garlic *Allium sativum*

It has a bulbous base made of separate segments called cloves, and grass-like leaves about 30cm tall. The flowers are white, appearing in the summer, and grown to 60cm tall. The cloves should be planted in mid-February or March, or in October, in a light rich soil on a sunny site. Plant them with just the tips showing above the soil surface, about 20cm apart in the rows, and with 30cm between the rows. Take the flowering stems off, and harvest the crop when the leaves turn yellow, and hang the cloves to dry in a warm shady place. Use a new site every year to reduce the risk of white rot attacks.

Garlic has a very strong flavour and odour, and should be used sparingly in cooking. It is sometimes thought to have considerable antiseptic and antibiotic qualities.

Horseradish *Armoracia rusticana*

Horseradish grows to 60cm tall. It is a perennial, with large basal leaves 30 to 60cm long, and produces small white flowers in May. The roots are fleshy and fanged. Be sure you really want it; it can be very hard to eradicate once established. Cultivation should supply a rich moist soil worked to a depth of

60cm. Plant 8cm root cuttings in March, 30cm apart, just covered with soil, in an individual bed. Lift all the plants in late autumn, store the larger roots in sand, and keep the smaller ones in a separate box of sand for planting the following spring.

In cooking, the peppery roots are grated, and generally made into horseradish sauce. It has antibiotic qualities, and aids indigestion.

Parsley *Petroselinum crispum*

This is usually grown as an annual, though in fact it is a hardy biennial. It grows to about 30cm high and 15cm wide. The leaves are deeply cut and curled, and there are tiny greenish-yellow flowers from June to August in the second year. For a summer crop, sow parsley seeds in March or April. Soak the seeds in water overnight; this will encourage germination, always a slow process with parsley. It will grow in moist soil, either in sun or shade. Rows should be 30cm apart, and the plants thinned to 15cm in the rows. Do not be surprised if no seedlings appear for up to four weeks.

For winter use, seeds should be sown in July, and protected under cloches in winter. It is a good container herb: 12cm pots are best. If you forget to make a summer sowing, pot a few of the earlier sown plants in October and keep them in the greenhouse or on the kitchen windowsill.

Parsley leaves have a strong and distinctive flavour, and are very popular for cooking. They contain a sizeable quantity of vitamin C. Parsley water is sometimes said to help get rid of freckles.

Sorrel *Rumex scutatus*

This is a hardy perennial plant, dying down in the autumn. The flowering stems can reach 30cm, and the spread is the same. The leaves are 4cm wide, and slightly fleshy. There are insignificant green flowers in summer. Plant in spring or early autumn in moist soil allowing 30cm between the plants; remove the flowering stems to encourage leaf production. Divide in spring or sow in April, thinning when the plants are large enough to handle.

The bitter leaves can be used to make sorrel soup, but should be used cautiously in other dishes on account of their very strong taste. They contain vitamin C.

Questions and tasks for comprehension.

1. What does a soil healthy balance mean?
2. What role do nodules play in rotation?
3. What crops “like” to take nitrates from the soil?
4. Four-year rotation-three-year rotation. Is there any difference?
5. What is the difference between frames and greenhouses?
6. What kinds of greenhouses do you know?
7. What do you know about herbs?
8. What is your favourite herb for cooking?

Task 1. Which words can fit these categories?

A: agronomy:

B: botany:
C: zoology:
D: agriculture:
Seed, root, manure, crop, leaf, to dig, compost, frame, fertilizer, weed, caterpillar, pigeon, maggot, cultivation, sowing, fly, spider, seedling, blanching, pest, ground, harvesting, a mature, humus.

Task 2. Compose three-year rotation table including varieties of rotating crops. Table 2 of this unit will help you.

Task 3. Sum up:

1. Temperatures in greenhouses.
2. Advantages of right rotation.
3. General notes on herbs.

Unit 3

In this unit you will find the answers for the following questions:

- Are there general notes on vegetables?
- How to sow and cultivate beetroot?
- How to protect beetroot from pests and diseases?
- How to cultivate carrots?
- What do marrows "like"?
- Have onions a long vegetation growing?
- Why do green peppers taste best?
- Why do we like potatoes so much?

General notes on vegetables

Sowing Always try to get the ground prepared well in advance of the sowing dates; most fertilizers, whether organic or inorganic, need time to work their way in. Ideally, you should just have to rake over the surface before taking out a drill and sowing, but of course if there has been heavy rain or prolonged drought, last minute digging will have to be done. But if you have dug the ground before the weather becomes bad, it will be very much easier to work and will repay dividends in the following spring and summer.

Cultivation Seed packets usually give ideal widths for planting distances. Unless you wish to exhibit produce, you will get heavier crops with closer plantings, although of course there are limits. Reducing specified spacings by 10% will produce adequate crops from more plants. Always leave yourself room to get between the rows to harvest however, and do not skimp on potato planting distances — otherwise not only will you be unable to dig them up properly, but there will be nowhere to draw soil from for earthing-up.

Pests and Diseases A healthy plant in a healthy soil is the best ideal to bear in mind. However, unless you feel strongly about chemical assistance, you will spray or dust your plants sooner or later rather than watch your crops disappear and die before your eyes. But remember to leave at the *very least* two weeks between the final treatment and harvesting, and if you are afraid that the time left may have been on the short side, wash all produce several times in clean water before cooking.

Varieties The cost of seeds is of course very much lower than the cost of produce at the greengrocer's, but even so, prices are rising rapidly, and you may be tempted to save your own seed. The correct method and storage procedures should be looked up in a more specialized work, but one important fact to bear in mind is that you should not try using seed saved from hybrids — it is unlikely to breed true, and the cases where it does will be outnumbered by those where it does not — Mendel's Law shows that three out of four seeds are likely not to breed true.

Beetroot *Beta vulgaris*

Beetroot is a maritime plant, requiring a sandy soil and one containing some salt. Before sowing the seed, dig a little common salt into the ground and add some superphosphate and sulphate of potash mixed together. The leaves can be eaten as well as the root; they should be cooked in the same way as spinach.

Sowing Seed can be sown in mid-April in the south, and early May in the north — the young plants can be harmed by frost. Like all root vegetables, beetroot

should not be grown on freshly manured soil, as this will cause the roots to fork. It does however like a soil which has been manured for a previous crop, one which is well-dug and finely raked, and a pH of about 6.

Seed should be sown in drills 3cm deep and 38cm apart. Soaking the seed overnight before sowing will speed germination. The seeds usually come in a group of three stuck together, so once the plants germinate, it will be necessary to remove the two weaker ones. Thin the remaining plants so that there is 13cm between each. Sowing should be carried out every month for succession, and the final drill should be sown in July for medium sized roots in late autumn.

Cultivation Beetroot must always be kept moist, as otherwise the roots will grow hard and woody and the plants run to seed prematurely in warm weather. Peat or spent mushroom compost will help with moisture retention, and will also lighten the soil. Hoeing should not really be necessary; the beetroot leaves will keep most weeds down. Hand weeding during germination is worth the trouble — you are unlikely to pull up the plants inadvertently, due to their distinctive colouring.

The younger the plants are pulled, the better the roots taste. Most catalogues suggest waiting until they are the size of a tennis ball, but try picking alternate plants along the row when they are the size of golf balls — these will be very tender, and there will be room for the remaining plants to develop to tennis ball size for winter use.

When lifting the roots, take care to ensure that they are not damaged, as with many varieties breaking of the skin or bruising can cause the plants to 'bleed' causing them to go pale pink when cooked, and to lose much of their flavour. Those not for immediate eating can be stored for the winter in boxes of dry sand or peat in a frost free place.

Pests and Diseases Phoma lingham causes young beet seedlings to turn brown and decay. It is carried in the seeds, and most are now packeted coated in thiram as a preventive measure. Another occasional trouble is downy mildew, which appears as a white powder on the undersides of the leaves. It should be controlled by spraying the plants with a weak Bordeaux mixture solution. Apart from these two occasional diseases, beetroot are a remarkably trouble-free crop.

Carrots *Daucus carota*

The best carrots are those sown and harvested early. Although it is such a staple part of our vegetable diet now, it was only at the beginning of the 18th century that carrots started to be prized for their food value rather than merely for their foliage.

Sowing The ground should have been manured for a previous crop; fresh manure causes the roots to fork. The best soil is a sandy, well-drained loam. Rake the soil to a fine tilth, and sow the seed in drills 1cm deep and leave 25cm between rows. Sowings can be made successionally from April until July, or a first sowing can be made under cloches in March. If your soil tends to be heavy, sow the short, stump-rooted varieties.

Cultivation As soon as the seedlings are large enough to handle, thin them to 5cm apart in the row, and about a fortnight later, thin them again to 10cm. These second thinnings can be used in salads or soups. During dry weather, water the plants regularly, and give them an occasional application of dilute liquid manure. As the

roots mature, make sure the tops are not above the soil, or they will turn green. Cover them with a little soil.

Lift the carrots as they are wanted, but those to be kept for the winter should be lifted before November and stored in sand or peat in a frost free place: if they are subjected to frost in the ground, or to excessive wet, the roots will split.

Pests and Diseases Carrot fly is the most serious problem. The larvae are attracted by the smell of the carrots, and burrow into the young roots making them virtually unusable. Dusting the seedlings with Lindex gives control. Split ting is a common problem with carrots; it is often caused by a heavy rain following a long period of drought, or by a soil deficient in potash. Steady watering during drought will help prevent it.

Marrows *Cucurbita pepo*

Marrows should be planted in full sun, but they need shelter from cold winds. Courgettes are marrows picked young for their delicate taste; however some varieties have been specially bred to produce a lot of small fruits rather than a small number of large ones.

Sowing Marrows resent being transplanted, so the best idea is to sow the seeds in individual 8cm peat pots. The pots should be filled with sowing mix, and the seeds pressed into it with their pointed ends towards the top, and just covered by the compost. Sowing should take place at the end of March, or in early April. The pots should be very thoroughly soaked, and placed just touching each other in the box or frame. If they are in a frame, the lights should be kept closed until germination has taken place, and the frame should be covered with sacking at night if April frosts are expected.

In early May, when the plants have formed their second pair of leaves, they should be gradually hardened off. By the end of the month, the plants should be ready for setting out.

Cultivation Marrows used to be planted on top of heaps of compost, but nowadays this must be thought an extravagant use of organic matter. Marrows will do perfectly well planted on the flat, but they must have as much humus as is available dug into the soil, and must always be kept moist.

When the plants are set out at the end of May, allow 90 to 120cm between bush varieties, and slightly more for the trailers. When the plants have made about 45cm of growth, pinch out the centre shoot to encourage the plant to form side shoots. A mulch of peat and rotted manure will do a lot of good, and watering with liquid manure from the time the first fruits begin to form is also beneficial.

When harvesting, do not allow the marrows (or courgettes) to grow to monster size; flavour will deteriorate, and the plant will be less likely to produce further fruits. Marrows will be damaged by frost, so make sure all, including those for storage, have been lifted by the first frost.

Pests and Diseases A white powdery substance underneath the leaves is the sign of a mildew attack. Routine spraying with Bordeaux mixture will prevent outbreaks. Slugs can be controlled with methiocarb pellets, and aphids by spraying with derris dust. Marrows can also suffer from cucumber mosaic virus, there is no cure for this, and infected plants should be burnt as soon as possible.

Onions *Allium cepa*

The onion needs a long growing season if it is to produce large bulbs, and so in more northern parts of the country it is advisable to plant sets rather than start from seeds, if a greenhouse is not available.

Sowing Sow the seeds in a heated greenhouse or frame in mid-January, and transplant into deep boxes of rich compost in March. Seeds can also be sown under cloches in early February, or in warm areas in October, and allowed to overwinter. Dust with calomel and then sow in shallow drills thinly.

Cultivation As onions may be grown in the same ground for several years, a special bed can be prepared, incorporating humus to a depth of 60cm, with some well-rotted manure added. The bed should be brought to a fine tilth and allowed to settle before planting.

Onions raised from seed should be set out in early April. Plant them with half the bulb showing above the ground, and dust with calomel to protect against onion fly attacks, four weeks later.

If sets are being used, press them into the soil, allowing 15cm between bulbs, and 30cm between the rows.

While the onions are growing, keep hoeing between the rows and water copiously in dry weather. Stop watering in mid-August to allow the bulbs to ripen, and bend over the tops, just above the necks, to assist the ripening process. When the leaves have turned yellow and shrivelled, the onions are ready for harvesting.

Pests and Diseases Downy mildew attacks the onions late in the season, appearing in the form of a white fungus coating the leaves, which can cause the leaves to die back, preventing the bulbs from developing. It occurs most often in a wet season, and should be controlled by dusting the plants with a mixture of lime and sulphur. Onion fly is by far the most troublesome pest; the flies lay their eggs in the soil in May and June, and the maggots tunnel their way into the bulbs. Dusting the bulbs before planting into calomel solution and dusting the growing rows with calomel dust should prevent attacks.

Smut attacks seedlings at soil level and is a notifiable disease: the spores can remain active in the soil for twenty years. To avoid attacks, immerse the sets before sowing in a mixture of 125ml of formalin in 181 of water.

A point worth noting is that autumn sown onion seeds are rarely subject to onion fly attacks.

Peppers *Capsicum annuum*

Sweet peppers are grown in a similar manner to tomatoes, to which they are related. They taste best if they are picked when they are green; they will gradually turn red, but although these will look attractive in salads and other dishes, there is a considerable loss of flavour and texture.

Sowing Sow the seeds in March in individual peat pots at a temperature of 16°C. When the seedlings are large enough to handle, they should be transplanted to 10cm pots, and hardened off if they are to go outside. If the plants are to be grown in the greenhouse, they should be potted on in to 20cm pots towards the end of May.

Cultivation Outdoor plants should be set out 40cm apart from one another in a sunny spot on rich soil. They can be kept under cloches until the plants become too

tall for these. Both indoor and outdoor peppers should be kept well watered, and weekly liquid manure feeds will improve the crop.

The growing tip of the plant should be pinched out when the plant is about 45cm high, and it may be necessary to stake the plants. The fruits should be ready for harvesting from August onwards.

Pests and Diseases Red spider is probably the worst pest of capsicums, sucking the sap out. A humid atmosphere will help the plants, and syringing the plants twice a day is one answer. Fruit spot can be recognized by the red indentations on the fruits, and infected fruits should be picked off and destroyed. Spraying with Bordeaux mixture will give control. Grey mould attacks all parts of the plant above the soil surface, forming large grey blotches. Avoiding crowding greenhouse plants is advisable to reduce the spread of infection, and control can be gained by spraying with shirlan.

Potatoes *Solanum tuberosum*

The potato is the most widely eaten vegetable in Europe.

Potatoes have a very useful quality: they will 'clean' land which is being brought under cultivation for the first time, providing plenty of manure is added. Perennial weeds are often difficult to eradicate, but the processes of cultivating and lifting potatoes clears the ground, and the manuring ensures that it is in good condition for future crops. Potatoes are unlike the majority of other vegetables in that they prefer a slightly acid soil. Add peat if you live in a lime area; otherwise there may be a tendency to scab. The ground should always be dug during the late autumn, so that the frost and wind can break it down during the winter.

Starting the Tubers Crops will be larger if the tubers are well-sprouted before planting, and this will also ensure the earliest possible crop. If a tuber has several eyes, it can be cut into pieces, each with an eye, but the plants from these will very probably only produce the same weight of crop as the one plant from the whole tuber — there is a fairly precise correlation between the weight of the original tuber and the ultimate weight of the crop.

Sprouting should be commenced about six weeks before the potatoes are to be planted. Do not plant too early; wait until the soil is in a friable condition.

Cultivation For heavy crops, take out a trench to a depth of 23cm and place 18cm of well rotted manure in the bottom, and the same amount of peat on top of this. Press the tubers into the peat about 50cm apart from one another, and leaves 60cm between the rows, mainly to allow room for earthing up. Remember you can use this space in the early stages of growth for catch crops of radishes, lettuces and carrots. Fill the trench up over the potatoes.

Potatoes like an open sunny position, with a maximum of sunshine. Ideally the rows should run from north to south so that both sides obtain the same amount of sunlight. If frost is expected, cover the rows with sacking at night; frost will probably not kill the crops, but it will give them a severe setback, and the first potatoes will not be ready until some days later than if they had been given protection. As the leaves appear above the soil, the foliage should be earthed up to 8cm and again a month later to a similar depth. At the same time, spray with Bordeaux mixture to prevent attacks of potato blight.

Harvesting Start to lift the potatoes when the foliage dies down; for early potatoes, start lifting at the beginning of June. Lift the tubers with a fork, taking care to start digging well away from the plant so as not to stick the tines through individual potatoes. After lifting, burn the haulm so that there can be no chance of disease being transmitted to the next year's crop.

Pests and Diseases Wart disease attacks the stems and lower leaves, and when the plants are lifted, the tubers have a swollen and knobbly appearance. Another pest is Colorado beetle. It has orange and black striped wings, and measure just over lcm when fully grown. It winters in the soil and lays orange eggs on the plants. The grubs are also orange, and are so destructive that they can wipe out a plantation in days. As a precaution, treat the soil with Aldrin dust before planting.

Black leg is the name for bacterial rot of potato tubers which can occur in a wet season. It causes slimy patches on the tuber and smells unpleasant when cut. Clean seed should be a sufficient precaution; cutting tubers increases the risk of spreading the disease. Blight is a disease which can cause serious damage, but can be prevented by spraying the foliage early in July with Bordeaux mixture, and make sure that potatoes are properly rotated so that the fungus cannot take a hold. The outward signs are dark brown blotches on the stems and leaves.

Eelworm is a pest which attacks the tubers making them slimy, and causing the foliage to turn yellow and die back. There is no known cure, and where an attack has occurred, it is best not to plant potatoes again for four years. In cases of minor attacks, treatment with Jeyes Fluid in water a month before planting has been known to work.

Scab is just what it sounds like: rough, scabby spots on the tubers. Where the infestation is severe, the whole surface of the potato may be covered. Green manuring before planting often prevents an outbreak. Leaf scorch is caused by potash deficiency, and is recognized by the tendency of the leaves to curl at edges. An application of sulphate of potash when planting the tubers should prevent an outbreak of leaf scorch.

Questions and tasks for comprehension.

1. What notes are the best for excellent yields of vegetables?
2. What kind of soil do carrots “like”?
3. Is there any protection against marrow pests and diseases?
4. What notes are the best for successful sowing of onions?
5. What notes are good for the best cultivation of beetroot?
6. How to sow and cultivate capsicum?
7. In what way do potatoes “clean” land?

Task 1. Here are some expressions with the words referring to the topic “vegetables”. Translate them into Ukrainian. Consult the dictionary, if necessary:

1. the stick and the carrot policy
2. as cool as a cucumber
3. not to have a bean
4. full of beans
5. not worth a bean

6. to spill the beans
7. to found the bean in the cake
8. to eat the (or one's) leek
9. to the marrow of one's bones
10. to know one's onions
11. as like as two peas
12. quite the potato
13. mint of money
14. mint of trouble
15. to be on nettles

Task 2. Choose the correct answer:

1. It may be grown in the same ground for several years.
    a) cucumber
    b) onions
    c) radishes
2. Start to lift it when the foliage dies down.
    a) tomatoes
    b) potatoes
    c) sweet corn
3. Pick beetroots when they are the size of …
    a) a golf ball
    b) a tennis ball
    c) a football
4. They taste best if they are picked when they are green.
    a) peas
    b) beans
    c) sweet peppers
5. Carrots started to be prized for their food value rather than merely for their foliage at the beginning of …
    d) the 19th century
    e) the 17th century
    f) the 18th century
6. Aubergines are also known as …
    a. violet plants
    b. eggplants
    c. oval plants
7. … are marrows picked young for their delicate taste.
    a. courgettes
    b. aubergines
    c. water-melons

Task 3. Sum up:

1. Potato is the second bread in Ukraine. Prove it.
2. Compare notes on sowing and cultivation of different kinds of vegetables. Are they similar?

Unit 4

In this unit you will find the answers for the following questions:

- What is cereal?
- Which cereals are the most important?
- Why have cereals received so much attention for domestication and development?
- What do you look for in quality seed?
- What do you avoid in seed selection?
- Why does week seed produce weak seedlings?
- Why is wheat produced?
- How does the wheat get from the farm to international markets?

Cereal crops

What is a cereal?

Man's most widely used crops are the cereals. Cereals are members of the grass family (Gramineae), which produce large edible grains either for human or livestock consumption.

The grain or seed (wheat kernels are seen here) is an edible fruit, consisting of the **endosperm** and the **embryo** (or **germ**). The endosperm is stored food and makes up the majority of the seed. White wheat flour consists of the endosperm of a grain of wheat. Wheat germ is also sold in stores and is used in many bread recipes.

Grains are rich in carbohydrates and contain substantial amounts of protein, as well as some fat and vitamins.

Why would they be grown?

Wheat, rice, barley, oats, rye (temperate climates) and maize (corn) (tropical /subtropical climates) are the six principle cereal crops, which, worldwide, provide over half of man's food energy and much of the essential proteins and vitamins.

Over 70% of the world's harvested area is planted to grains, for an output of a billion and a half tonnes a year. Sorghum, and millet are also used in subtropical and tropical countries like Asia and Africa.

Cereals are excellent converters of energy (wheat is almost twice as efficient as the potato at converting the sunlight's energy into food). They are principally grown as an energy source with maize being the highest, and oats the lowest. They are also a good source of protein (4-16%), but have a poor amino acid balance (being deficient in lysine and methionine).

Cereal crops also have industrial uses including;

- paper
- adhesives
- food thickeners
- and food preservatives

Which cereals are the most important?

On a world scale, wheat and rice are the most important cereals. They are used directly for human consumption (as is rye).

Maize, barley, and oats are principally animal feed. The most widely used animal feeds are different pasture grasses, which may be grazed, harvested and fed as hay or fermented to be fed as haylage or silage.

Why have cereals received so much attention for domestication and development?

There are many reasons that cereals were domesticated and have been used so extensively for agriculture. A few of this reasons are listed.

- Members of the grass family are hardy and well adapted to a wide range of growing conditions. They are found everywhere that plants grow.
- Due to the fact that annuals are selected, food production is ensured each year, and in some areas, more than once a year.
- Fully ripened grass seeds are fairly small, with a very low water content. This enables them to be transported and handled easily, as being able to be stored under cool dry conditions for a long period time. The lower water content also means that the seed has higher energy value.
- Wheat, rice, and corn supply most of the plant energy to the world today.
- Rice is grown in almost 90 countries, mostly consumed locally. It provides from 25-80% of the daily caloric intake of nearly half of the world`s population.
- Wheat has the highest protein content of any cereal, and is the highest in production and trade volume.

Selecting quality seed of cereal grains.

Farmers are particular about the variety of seed they grow. That means they understand the advantage of improved genetic potential. They should also be aware of the agronomic characteristics of the seed lot they select. After variety selection, the most emphasis must be put on obtaining and maintaining top quality planting seed. A seed contains a young, live plant (the germ) and a supply of food to start the young plant (the endosperm).

What To Look For In Quality Seed

Quality seed can be selected on the basis of both appearance and tests. Spreading out a representative sample in a single layer on a table top gives excellent opportunity to observe physical quality and condition of the seed. Testing, however, is the only reliable means of determining the ability of seed to germinate and the presence of disease, such as loose smut content of barley.

Quality seed should have the following characteristics:

Purity

Varietal purity usually cannot be determined by looking at the seed nor by a laboratory test. Using certified seed, having absolute knowledge of the source, reading the seed tag and relying on the credibility of the seller are the only ways to be sure of purity.

Seed should not be mixed with other classes or crops, especially those that mature at the same time and will be removed as dockage or be a market grade factor.

Weed seeds—no prohibited or restricted noxious weeds, low levels of other weed seeds.

Inert material—free of sticks, chaff, stones, parts of insects, dirt, cracked seed, etc. This material may not be injurious to the field or crop produced but adds to the seed cost and may interfere with uniform seeding.

Germination

Germinability of seed cannot be determined by visual inspection. Testing a good representative sample is the only way to be certain the seeds will grow. Minimum germination of good seed is:

Hard red spring wheat	90%
Durum wheat	85%
Hard red winter wheat	90%
Barley	90%
Oats	90%
Rye	80%
Flaxseed	85%

What To Avoid In Seed Selection

Many factors can cause kernel damage, making a lot of grain unsuitable for seed. Such damage should be looked for and avoided when choosing seed or grain that is to be conditioned and made into planting seed.

Weather damage: Can be simply a loss of color and a lowering of test weight. If the germination is satisfactory, plant weather damaged seed at a normal rate. With stress conditions during germination, seedling vigor may be reduced sprout.

Sprout damage: Varying degrees of sprouting are possible (Table 1). Slightly sprouted grain will resprout several times if it is dried to safe storage levels between each sprouting so molds do not develop. Moldfree seed will continue to resprout as long as the coleoptile (stem) is not broken off in threshing and handling, or until the food reserve in the kernel is exhausted. Each time the kernel resprouts, the seedling is weakened.

Table 3: Germination Percentage of Hard Red Spring Wheat With Different Degrees of Sprout Damage.

	Lot	**1Lot**	**2Lot**	**3Lot**	**4Ave.**
	%	**%**	**%**	**%**	**%**
A	96	91	98	92	94
B	54	67	80	73	68
C	11	16	18	52	24

A = Weather damaged but no sprout showing.

B = Sprouted, germ end split only.

C = Easily visible sprout damage.

Frost damage: Lowers test weight and germination. Grain with visible although slight frost damage will be lower in germination and have reduced seedling emergence.

High moisture in storage: Wheat, rye, oats and barley that went into permanent storage with more than 13 percent moisture, or flax with over 9 percent, should not be used for seed. Damp stored grain is likely to develop molds and will heat and spoil when the first warm weather occurs in the spring. Never use moldy, heated or spoiled grain for seed. Even if the mold damage is not indicated except as a dull grayish color or as a slightly musty odor, the viability of the seed may be injured.

Heat dried grain: Grain mechanically dried at temperatures over 110 degrees is not suitable for seed. Such drying injures germination.

Spring harvested grain: Grain left unharvested over winter has little or no value as seed, especially if it entered the winter with high moisture.

Low test weight may result from any of several causes such as:

(a) Weathering, sprouting and frost as just discussed.

(b) Diseased kernels caused by head blights and scab result in shriveled, low test weight kernels. These kernels produce weak and diseased seedlings. Many such kernels can be removed by heavy cleaning if it is necessary to use such a lot for seed.

(c) Seed that is shriveled by drought, or by plant diseases such as rust or leaf diseases which cause the crop to ripen prematurely, may actually germinate well. While low test weight seed may germinate quite well, the size and vigor of young plants produced from such seed are considerably less than from good, plump seed (Table 2) and yield is reduced (Table 3).

Table 4: Average Plant Green Weight of 100 Wheat Seedlings From Shriveled and Plump Seed.

Test weight range	**Weight of 100 plants (grams)[1]**
(lb/bu)	
60–check	10.9
54–54.9	7.1
45–49.9	4.6
40–44.9	3.8

[1]Weights recorded about 14 days after emergence.

Table 5: Effect of seed test weight and planting depth on hard red winter heat grain yield.[1]

	Seeding depth	
Test Weight	**Normal**	**Deep***
	(Grain yield in bu/acre)	
58	59	46
62	61	52

- Deep planting was one inch deeper than normal.

Diseases. Diseased seed, even though plump and of good test weight, with dark brown, black, pink or grayish colored kernels, should be avoided even though these are surface borne and may be helped considerably by seed treatment.

Small kernel size within variety: Small kernels may germinate very well, but the seedlings will be smaller and weaker. Emergence is less, seedlings make slower early growth, tiller less, have less vigor and individual plants yield less from small seed than from plump seed (Table 4). Such seedlings are less able to compete with early weed competition, seedling diseases and other early growing season stress.

Table 6: Effect of Seed Size on Seedling Emergence and Grain Yield of Barley and Hard Red Spring Wheat.

	Stand		**Grain yield**	
Seed Size	**Barley**	**Wheat**	**Barley**	**Wheat**
	(Plants/ft^2)		(bu/acres)	
Small	26	35	82	44
Medium	25	36	85	45
Large	28	39	87	48

Old seed: Small grain and flaxseed in good storage at safe moisture levels will hold its germination for two or three years. After that, germination will drop slowly on wheat, barley and oats and will drop rapidly on flax and rye seed.

Low germination: All seed should be tested for germination. A good representative sample is needed for an accurate test. Only good, healthy, normal sprouts should be counted as live seed.

Weak Seed Produces Weak Seedlings

Regardless of the cause, weak seeds produce weak seedlings and should not be used except in extreme shortage of good seed. Weak seedlings cannot withstand adverse spring growing conditions nearly as well as strong vigorous seedlings; this can have a considerable impact on final crop yield (Table 6).

Table 7: Effort of Seed Vigor on Hard Red Spring Wheat Yield.

Vigor Rating*	**Grain Yield**
	(bu/acre)
Low	84
Medium	87
High	90

*Rating based on standard germination test and seed respiration rate tests.

Low vigor seed, small seed, or plump vigorous seed sown in a field on the same day may emerge at about the same time, although the emergence from plump seed will be more even and vigorous. Soil crusting, deep sowing and seedling diseases are more likely to cause poor stands from weak seed than plump vigorous seed.

Unfavorable spring growing conditions following emergence are likely to affect seedlings from low quality seed more than those from high quality seed. Drought sufficient to cause wilting will result in many weak seedlings dying while vigorous seedlings survive. Weak seedlings can result in thin stand and plants which grow slower, tiller less, are more easily attacked by diseases and less able to compete with weeds. Results from using low quality seed will depend on temperature, soil moisture conditions and disease following germination.

Seeding Depth

A good, firm seedbed is essential so the seed will always be in close contact with moist soil. A firm seedbed protects against drought and helps to prevent sowing too deep. Seed planted too deep results in poor and slower emergence and requires higher seeding rates to obtain a full stand. Plant as deep as necessary to obtain good

seed to soil contact. Semi dwarf spring wheat should be planted no deeper than 2 inches and tall wheat no deeper than 3 inches. Ideal planting depth for wheat is 1.5 to 2 inches.

Seeding Rates

Spring sown small grains of good seed quality usually are seeded 12 to 20 seeds per foot of row. This results in a final stand of 8 to 16 mature plants per foot of row. Normally, crops sown early tiller more then late sown crops. Less productive land tillers less and the seeding rate should be increased. If seed is not top quality, the rate also must be increased. When growing conditions are adverse and the crop retains fewer tillers, then yield must be obtained from main stem heads.

Cleaning or Buying Seed

Planting large, plump, good test weight, disease free high quality seed never results in a lower yield. In seasons less favorable for establishing good stands, high quality seed can be the difference between a good crop yield and a poor yield.

When purchasing seed buy the best. Check it for the many qualities that good seed should have. When cleaning your own seed or having it custom cleaned, be sure a good cleaning and sizing job is done. This normally requires shrinking the lot anywhere from 20 to 50 percent or more after dockage is removed. This cleanout has commercial value but contains small and broken seeds, some weed seeds and other material undesirable for seeding purposes. Save only the large, plump, healthy seeds for sowing. GOOD SEED DOESN'T COST, IT PAYS!

Wheat

Wheat is one of the world's most important grains, with annual world production of 600 million tonnes. Wheat contributes between 10 and 20% of the daily caloric intake of people in over 60 countries.

According to plant breeders using the scientific classification system (binomial nomenclature), wheat belongs to the:

- grass family **Gramineae (Poaceae)**
- tribe **Hordeae**
- genus **Triticum**
- species **aestivum**
- variety **cultivar**

Most wheat currently grown consists of three species of triticum, each with a different country of origin. Probable countries of origin of Triticum wheat include Southeastern Turkey, Near East, former Soviet Georgia, Trans-Caucasia and Caspian Sea.

Wheat grows approximately 1 m high having grain on a **rachis**. Kernels of wheat range from 5 to 8 mm in length and 2.5 to 4.5 mm in width. Average kernel weights are around 37 mg, but may range anywhere from 20 to 60 mg.

Why is wheat produced? Wheat has many advantages which have resulted in it becoming one of the most important cereal crops in the world.

Wheat is easy to grow, flourishing in many different soils and climates. The grain is easy to handle, store and transport.

Most importantly, wheat and rye are the only two cereals which are able to produce **leavened** bread due to a substance called **gluten**. Gluten is a grayish-white, flour-like substance which is concentrated in the outer part of the seed (bran). When combined with water, gluten produces a gluey substance which gives dough it's elasticity, enabling it to capture air bubbles and "rise", which is important in making light loaves of leavened bread.

In terms of energy efficiency, wheat is quite good. In the form of bread, wheat contains more energy than is used to grow, harvest, mill, bake and transport it to marketplaces.

Where is it produced?

Around the world, 2.5 million square kilometres are used for growing wheat. The most important area is the mid-section of Canada and the United States, Ukraine and Russia. It is in this area that wheat is grown using the most efficient methods; in huge fields, being harvested by great combines.

In order to produce good quality, high protein seeds, wheat needs a cool, moderately moist early growing season, with abundant sunshine and gradual drying and warmth for the remaining growth period.

Wheat is primarily used for human consumption. Wheat is ground into flour which is then made into products such as bread, cakes, cereal, macaroni, and noodles. Other uses include the manufacture of alcohol, uses of extracted gluten, and livestock feed. The varieties **Hard Red Winter** and **Hard Red Spring** classes are used primarily for leavened bread production. **Soft Red Winter** and **Common White** wheat classes are used for pastries, crackers, and cookies. **Durum wheat**, a species with an extremely hard grain, is used for macaroni, spaghetti, and other pasta products. It is often used for arabic flat bread in North Africa and the Near East. Hard wheats contain greater protein levels, whereas the soft wheats have lower levels.

Whole wheat flour is made from the whole kernel, including the nutrient-rich bran and wheat germ.

White flour is made from the endosperm, which is primarily starch. The bran and wheat germ are the main source of most of the nutrients in whole wheat flour. Bread is often called "the staff of life", because it is an essential part of the human diet. Whole wheat bread is a particularly nutritious food, and excellent source of carbohydrate, protein, B vitamins, mineral and fibre.

Whole wheat bread contains less saturated and unsaturated fat than enriched white bread, and is a wise choice for health-conscious consumers.

How is it produced?

Through plant breeding, scientists develop new varieties which are higher yielding and have more disease resistance. Farmers who specialize in seed production multiply seed of these varieties for commercial farmers to plant.

Farmers prepare the fields for planting. Most farmers plant in the spring and harvest in August and September. Some farmers (about 0.6 %) plant winter wheat in September or October. Winter wheat is harvested in late July and early August.

Before planting a crop, farmers prepare their fields for seeding. This entails cultivating the soil, usually applying fertilizers and then seeding the crop using a seed drill. If required, herbicides for weed control are used.When the crop ripens, it is harvested. Wheat is ready to be harvested when it is about 1 metre high and the colour

changes from green to golden. A head of wheat contains 30-65 kernels of grain. The crop is cut and allowed to dry on the field. A combine is used to separate the seeds from the chaff and straw. Harvested grain is stored in granaries. It is important to maintain specific moisture levels in grain to ensure that it does not become mouldy.

How does the wheat get from the farm to international markets?

- Grain is delivered by truck from the farm to the local elevator where it is weighed, unloaded and sampled to determine the grade of the grain. This grade determines the price the farmer is paid for the grain.
- An elevator agent grades the grain according to Canadian Grain Commission standards for quality, appearance, plumpness and density. Once the grain is graded, the agent mechanically transfers it to a bin in the elevator holding the same grade of grain.
- Grain for domestic use is shipped via rail from the local elevator to the mill for processing. Wheat for export is transported, also via rail, to one of several large terminal elevators where it is cleaned to export standards.
- Grain destined for export is loaded at the terminal elevators onto bulk grain freighters and shipped all over the world.

The costs of moving wheat from the farm to the grain elevator include purchasing and maintaining grain trucks, as well as the ever-increasing price of fuel. Farmers transport wheat in the fall, after harvest, and at other times during the year when price and market may be more favourable.

Canada exports wheat to over 60 different countries. China, the countries of the former U.S.S.R., and Asia are large importers of Canadian wheat.

The Canadian Wheat Board is the sole marketing agent for wheat grown in Canada. Selling wheat to foreign countries can be complicated by political change and upheaval, as well as by competition from other exporters of wheat, like the United States and the European Economic Community.

The Wheat Board may sell wheat directly to a customer, or it may sell through accredited exporters, making use of the expertise of private traders with offices and contacts throughout the world. Sales and market development are the major focus of the Wheat Board. The Board backs up its sales initiatives with up-to-date analyses of trends in the world wheat trade.

Questions and tasks for comprehension.

1. What principal cereal crops do you know?
2. How can we use cereal crops?
3. Is it useful to consume cereal crops?
4. What are the main characteristics of a quality seed?
5. What are the main damages of the seed?
6. Describe a diseased seed.
7. What kind of seedling will be, if the seed is weak?
8. Can you explain the following “Good seed doesn’t cost, it pays!”
9. Why are wheat and rye the best for producing baking flour?

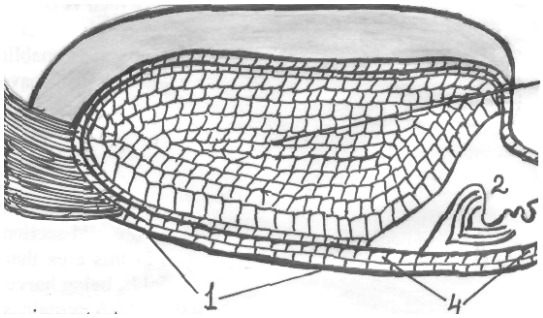
Task 1. Put the following scientific classification system of wheat in the correct order:

- variety Cultivar
- grass family Poaceae
- tribe Hordeae
- species Aestivum
- genus Triticum

Now translate it and learn by heart.

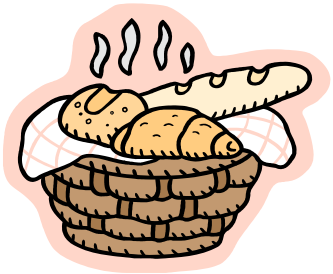
Task 2. Name the main components of the wheat grain:

a) pericarp
b) kernel
c) germ
d) endosperm



Task 3. Sum up:

1. Prove that cereals are important.
2. Describe a quality seed and an unquality one.
3. Explain the proverb: "Bread is the staff of life".



Unit 5

In this unit you will find the answers for the following questions:

- Why is barley produced?
- What does barley look like when we use it?
- How are oats used?
- What is so good about rye?
- What are main morphological characteristics of corn?
- What is corn growing range?
- What are diseases, insect pests and weeds of cereals grains?

Barley

Barley (and oats) have a long tradition among *Old World* farmers. At one time, barley and oat crops possibly were the most important cereal crops on the earth. The use of barley for the production of malt and for brewing has been a well-established tradition. Of all the cereals, Barley has the greatest tolerance for climate extremes and has been grown successfully from the sub-tropics to the sub-arctic

Barley is a cereal grain, and therefore belongs to the:

- grass family **Gramineae (Poaceae)**.
- tribe **Triticeae**
- genus **Hordeum**.

The main taxonomic description of Hordeum is it's one-flowered **spikelet**. Three spikelets alternate on opposite sides of the flat **rachis** of the **spike** (head). This forms a triplet of spikelets on each node - the central and two laterals. Each spikelet is subtended by two **glumes**.

When all three spikelets are fertile, it is considered six-rowed barley, when only the central spikelet is fertile it is considered two-rowed.

Barley has been associated with the earliest beginnings of agriculture in the Near East. The most likely origin of cultivated barley is from a wild ancestor growing in the fertile crescent 35000-40000 years ago. This ancestor may have developed into the present two-row wild-type weed barley (Hordeum vulgare sp. Spontaneum) as well as the cultivated H. vulgare two and six-row types. In addition to traditional 2-row and 6-row barley varieties have been developed for food application, where a minimal amount of cleaning is required prior to processing.

The oldest barley samples were found in the Near East from there it is thought that barley cultures spread to Europe, west Asia, and the Nile valley. There is now evidence that barley was under cultivation in India and China considerably later than in the Middle East. Historically and today, barley was and is an important crop, associated with the production of beer, and as a human food and animal feed crop.

Why is barley produced?

Barley has many advantages which have caused it to become one of the most important cereal crops in the world. Barley is hardy and easy to grow, flourishing in many different soils and climates. The grain is fairly easy to handle, store and transport. Barley has excellent nutritional value - a high fibre low cholesterol food, often used in human and animal food.

Where is it produced?

Around the world, 55 million hectares (136 million acres) are used for growing 141 million tonnes of barley annually. Canada produces about 11 million tonnes annually. The highest commercial yields for barley tend to come from central and northern Europe.

Global barley **production** is dominated by the EU, Canada, Australia and the US. Canada ranks second, producing 7-8% of world's barley (next to EU). The EU accounts for over 41% of world barley **exports** followed by Australia at 21%, Canada 13%, then Ukraine and USA at 6% each.

Barley grows well in similar temperature conditions to wheat, but, unlike wheat, barley has a greater tolerance of frost, drought, and saline soils, as well as requiring fewer days to mature. Barley is planted in the same areas as wheat, but due to its extra hardiness, it can be planted farther north. Barley is the grain of choice if a marginal area has a later spring or if planting is delayed due to wet weather since it has a short growing season. Other good points about barley are its ability to germinate rapidly, smothering weeds, as well as early harvesting which allow it to be harvested before many weeds scatter their seeds. A limitation of barley is its poor adaptation to wet and acidic soil conditions.

What does it look like when I use it?

Barley varieties have three main uses;

- Production of malt (largely for the brewing industry, sometimes as food malts for syrups, candy, and other flavorings).
- Human food – used in production of flatbreads, baby foods, gluten-free products, in soups or as a rice imitation.
- Animal feed.

When barley is used for malt, the grain is soaked in water, under controlled conditions, allowing it to germinate or sprout (known as green malt). It is then dried or roasted in a kiln, cleaned, and stored. Malt by-products are used as animal feed. Most of the malt is used to make beers and malt whiskey. Malt is also used in food preparation such as cakes and breads (e.g. pumpernickel).

How is it processed?

Barley is processed similarly to wheat and other cereals. This high-energy cereal is processed by removing the fibrous outer hull, bran and germ. The high starch levels in the seeds makes barley a good source of energy.

Oats

The exact history of oats is a mystery. The Asia minor region is accepted as the origin of the wild oat species (Avena sterilis and A. fatua) believed to be the cousins of cultivated oats. The issue of which wild type is the progenator of today's oats is under debate. It is thought that Slavs and Scthians (warlike horsemen from the Black Sea in Central Asia) migrated over many regions carrying various cereal grains with them. Through natural selection for the northern environments, hardy species survived, resulting in A. sativa becoming the most commonly used cultivated type in Northern Europe.

How are oats used?

High levels of protein and essential minerals make oats an excellent livestock feed. The high fibre content of oats is mainly in its outer hull, aiding digestion and reducing some feeding problems which may be a problem with other feeds. A small portion of oats are used for human food, in production of oatmeal (rolled-oats), oat starch, and cookies. Oats and oat bran have been popular health food products beneficial in lowering cholesterol levels. This increase consumption by humans has resulted in more of a demand for high quality oats. A more recent use of oats is in cosmetics. Two active ingredients with beneficial properties for the skin are avenanthramides and beta-glucan. These compounds are ingredients in cosmetic creams, gels and soaps and are used as anti-irritants and as aids in skin regeneration after damage by sun etc. Industrially, oats are used in the production of plastics, pesticides, and preservatives and oats are used in the paper and brewing industries.

How much is produced?

World oat production has halved over the last thirty years. One reason for the decline is that barley has replaced oats in animal feeds since barley is much more tolerant to harsh climates than oats. Nevertheless, oats still make up approximately 3-5% of world course grain production, ranking seventh in the world cereal production after wheat, maize, rice, barley, sorghum and millet. In contrast to other grains most oats are consumed domestically and there is little export trade.

Around the world, over 12.9 million hectares (31.9 million acres) are used for growing some 27 million tonnes of oats annually. The highest commercial yields for oats tend to come from the Netherlands, Switzerland, West Germany, the United Kingdom, Ireland, Sweden, and France. In terms of global oat production, Canada ranks third, producing 10.0 % (2.9 million tonnes) of world's oat production, the EU is the largest producer of oats.

What's so good about oats?

Oats do very well in conditions too cool and too wet for other cereals. Due to this characteristic, oats are often sown in low areas or sloughs where seeding may be delayed due to wet conditions. On a world scale, oats grow well between latitudes of 35 - 50° north and 20 to 40° south. Days to maturity (94 to 96) is close to that of wheat yet oats can germinate in cool, damp soils.

Rye

Rye is listed as one of the major cereal crops of the world. Rye is the only other major cereal capable of producing a leavened flour product which yields a dark, heavy bread.

Rye belongs to the grass family of the genus **Secale.** The species **cereal** is the only form that is extensively cultivated. It is a relatively recent addition to the cereal grains. It was not found in any Egyptian ruins or Swiss lake dwellings, but was known by the Greeks and Romans. Rye may have been cultivated in northern Europe. Samples of "wild" rye (**Secale montanum**) have been found in Neolithic sites of Austria and Poland. Cultivated rye may have been domesticated from the Mediterranean region (**Secale montanum**) or may have originated from **Secale anatolicum** of southwestern Asia.

Rye is thought to have been brought to North and South America by European settlers in the sixteenth and seventeenth centuries. During the nineteenth century it was introduced into South Africa and Australia. Today, it has the widest distribution of all the cereal crops.

What is so good about rye?

Of all the cereal crops, rye has the greatest tolerance to different climatic or soil conditions. Compared with other winter cereals, rye is the most cold-tolerant cereal crop available. New semi-dwarf varieties allow for straight combine harvesting and do much to reduce the weak straw and shattering problems of the older tall varieties. Rye is usually (80-90%) grown as a winter crop (planted in the fall as a cover crop to offer protection against spring wind erosion, as well as getting a head start on the spring planted crops and weeds). Since rye is usually planted in the fall it is also harvested earlier (late July or early August). Fall growth has advantages for livestock operators as well, allowing late season grazing.

How is it used?

The greatest use (over 50%) of the rye grown in North America is animal feed. Rye has anti-nutritional factors (beta-glucans and pentosans) which limit the amount able to be fed to livestock. Rye is not used in chicken feed as it has a laxative effect. The feeding value (energy equivalent) for animals is equal to Barley and about 10% greater than oats and 5 % less than wheat. Rye can be added for up to 45% of the cereal concentrate for dairy cows, 80% for beef cattle and 70% for pigs can be used. The rye plant cross-pollinates, and so, is susceptible to a **mycotoxin** (fungus-poison) called **Ergot**. Ergot fungus can release a toxic compound which causes blood thinning, hemorrhaging and abortions in both animals and humans. Due to these problems, rye feed is blended with other grains to make a safe, cheap ration.

The next largest use of rye is in the production of alcohol for rye whisky (in order to be considered a rye whisky, over one-half of the original grain mash must be rye).

Thirdly, rye is used for human consumption in the form of bread, crackers, and cereals. Bread produced with rye is smaller, has a darker colour, and a more distinctive flavour than that produced by wheat. More rye is used for bread and other foods in Europe than in Canada. Dark rye breads are common in Eastern Europe, Russian and Belarus and the lighter rye breads are more common in Germany, Scandinavia and North America.

Maize

Indian corn or **maize** is classified as **Zea mays**, with the probable area of origin being Mesoamerica. This grain is the world's third most important grain for human consumption. Corn plants vary in height from 60 to 700 cm and support an 'ear' weighing 450 g. Corn is regarded as a warm season crop. It has adapted to live in regions ranging from the semiarid to wet environments; and grows in warmer parts of Canada, in the United States, throughout Mexico and Central America, central Argentina and Chile, Africa, Central Europe and Asia. Corn has the most variety (five classifications) of all the grain crops. We are most familiar with three of these; flour, pop and sweet.

Maize is one of the most important cereals, specifically as an animal feed. Unlike other cereals, corn will not germinate until the temperature approaches 12 °C and it stops growing after 36 °C (compared to wheat's 1 °C to 40 °C). This means that corn has a smaller growing range than the cold season cereals. The smaller growing range and a greater number of days to maturity (110 to 130) put corn at a distinct disadvantage for growth in some regions. In addition, corn requires fairly high precipitation at regular intervals during the growing season. All of these factors have so far limited the growth of present maize varieties to some areas and only if early seeding is possible.

Maize production

Maize is ranked second to wheat among the world cereal crops. Some 70 countries produce maize 100,000 hectares or more, 53 from the developing nations. Developed market economies account for 30% of the global maize area, but provide 50% of the total production as their average yields are three times higher than the world average. Developing nations accounted for 60% of the world total maize area, but produce only 40% of the global harvest.

Sixty four percent of the maize produced in the world and 72% in the developed markets is used as animal feed. Less developed countries use 48% of their grain maize for animal feed and eastern Europe and former USSR use 79% of their maize for animal feed. Maize used directly for human consumption accounts for only 21% of the world maize production. Developed markets, less developed countries and eastern Europe and former USSR use 14, 40and 4% of the maize produced directly as human food.

Nutritional value of maize

Maize is utilized in more ways than any other cereal. As human food, as feed grain, fodder crop, and for industrial purposes. Its grain, stalk, leaves cobs, tassels and silks all have commercial value, although that of the grain is the highest. In the US, over 1,000 products in supermarkets contain maize in one form or the other in their makeup. Maize can be found on shelves in such products as corn meal, bread, flour, tortilla chips and baby food. Maize is also a popular treat for summer picnics as corn on the cob and a movie isn't a movie without popcorn.

Types of maize

There are many races of maize available. They can be grouped into five major categories, mainly the dents, flints, floury, pop, and sweet corn. Dent corn has kernels that are very hard and vitreous with a soft floury central core. Flint corn kernels are very hard and thick. Floury corn has kernels which are soft and non-vitreous endosperm which makes it easily ground. Pop corn is an extreme form of flint corn and sweet corn has translucent kernels which contain a sugar gene which inhibits the conversion of sugar to carbohydrates.

Diseases

Scald (*Rhynchospoium secalis*), Stripe (*Pyrenophora graminea*), Net Blotch (*Pyrenophora teres*), Spot Blotch (*Cochliobolus sativus*), and smuts (*Ustilago spp.*) are all infecting cereal grains. Growers lessen the incidence of the diseases by rotating crops and selecting seed from fields with minimal disease infestations.

Insect Pests

Occasionally an outbreak of grasshoppers occurs. The migratory (*Melanoplus sanguinipae*) and band-winged (*Camnula pellucida*) grasshoppers are the two most common. Insecticides have not been necessary to control these insects since 1992 when late spring and early autumn snows interrupted their life cycles, causing drastic declines in their populations. Field scouting and late fall or early spring tillage of grasshopper egg beds is occasionally used to help control their numbers. A parasitic fungus (*Entomophaga praxibuli*) was experimentally released in the Delta Junction area in the early 1990's. The fungus has been observed on deceased grasshoppers for several years. Evaluation of this fungus is continuing.

Weeds

Cereal grains can experience severe competition from uncontrolled weeds. Fields are often fallowed to control weeds, interrupt disease cycles and conserve soil moisture. In this effort, growers are employing more chemical fallow for improved weed control, less soil erosion, conservation of soil moisture, fuel, equipment use and labor. The more problematic common weeds are lambsquarter (*Chenopodium album*), shepherd's purse (*Capsella bursa-pastoris*), chickweed (*Stellaria media*), hawksbeard (*Crepis tectorum*), wild buckwheat (*Polygonum convolvulus*), corn spurry (*Spergula arvensis*) and bluejoint reed grass (*Calamogrostis canadensis*). A few noxious weeds are becoming established including wild oats (*Avena fatua*), hempnettle (*Galeopsis tetrahit*), quackgrass (*Agropyron repens*), and perennial sowthistle (*Sonchus arvensis*). Because of the limited amount of spring precipitation, it is extremely important to conserve soil moisture to permit early germination of the crop. This enables a more competitive crop and also allows rapid crop development to the desired growth stage for effective herbicide utilization. Field scouting is used to identify the types of weeds, their economic thresholds, stage of growth of both weeds and crops and then selection of the most desirable herbicide control program.

Questions and tasks for comprehension:

1. What is the history of barley as a crop?
2. What are the uses of barley?
3. What are the uses of oats?
4. Why do people like oat flakes?
5. What are the uses of rye?
6. What is the history of rye as a crop?
7. What kind of distinguish features has rye?
8. What weather conditions are ideal for growing corn?
9. Why do all over the world like to consume corn?

Task 1. Describe six-rowed barley and two-rowed barley. Use the following words: spikelet, rachis, spike, triplet, glumes, node, central, lateral.

Task 2. Grains on parade.

Fill in the following worksheet.

Name:_____ Period:_____

Date:_____ Group №:_____

1. The seven types of cereal grain are:
2. The most widely used cereal grain is:
3. The word "cereal" comes from the Roman goddess:
4. The most widely used grains in Ukraine are:
5. The brown outside covering of the grain kernel that contains carbohydrates, minerals, protein and vitamins is:
6. The inner portion of the kernel is:
7. The tiny living part of the kernel that contains proteins, vitamins, minerals, carbohydrates and fat is:
8. The special protein found in wheat is called:
9. The other name for vitamin B_1 in whole grain is:
10. The deficiency disease caused by lack of vitamin B_1 is:
11. Vitamin B_1 is needed by the body for : (give five reasons)

A.
B.
C.
D.
E.

12. Starch is used in the body for:

Task 3. Sum up:

1. Cereals are useful for our health. Prove it.
2. Cereals are for multipurpose use. Give examples.

Unit 6

In this unit you will find the answers for the following questions:

- What are oilseeds?
- What are the main uses of sunflower?
- What kinds of environment requirements are important for sunflower?
- What are fertility and lime requirements for sunflower growing?
- How to control pests and diseases?
- What is the best time for sunflower harvesting?

Oilseed crops

Oilseeds are plant species whose seeds contain high oil content (20-50%). Oilseeds are members of many different families and species, which produce oils and fats either for human and livestock consumption, or for industrial applications.

All of the oilseeds, except sunflower, have tiny seeds which require shallow seeding. This means that the upper layers of the soils must be moderately fertile and moist for the seeds to germinate quickly. With these requirements and their preference for cooler temperatures in the early growing season, oilseeds are more common to the parkland than to other growing areas.

Sunflower.

I. History:

Sunflower (*Helianthus annuus* L.) is one of the few crop species that originated in North America (most originated in the fertile crescent, Asia or South or Central America). It was probably a "camp follower" of several of the western native American tribes who domesticated the crop (possibly 1000 BC) and then carried it eastward and southward of North America. The first Europeans observed sunflower cultivated in many places from southern Canada to Mexico.

Sunflower was probably first introduced to Europe through Spain, and spread through Europe as a curiosity until it reached Russia where it was readily adapted. Selection for high oil in Russia began in 1860 and was largely responsible for increasing oil content from 28% to almost 50%. The high-oil lines from Russia were reintroduced into the U.S. after World War II, which rekindled interest in the crop. However, it was the discovery of the male-sterile and restorer gene system that made hybrids feasible and increased commercial interest in the crop.

II. Uses:

A. Edible oil:

Commercially available sunflower varieties contain from 39 to 49% oil in the seed. In 1985-86, sunflower seed was the third largest source of vegetable oil worldwide, following soybean and palm. The growth of sunflower as an oilseed crop has rivaled that of soybean, with both increasing production over 6-fold since the 1930s. Sunflower accounts for about 14% of the world production of seed oils (6.9 million metric tons in 1985-86) and about 7% of the oilcake and meal produced from oilseeds. Europe and the former USSR produce over 60% of the world's sunflowers.

The oil accounts for 80% of the value of the sunflower crop, as contrasted with soybean which derives most of its value from the meal. Sunflower oil is generally considered a premium oil because of its light colour, high level of unsaturated fatty

acids and lack of linolenic acid, bland flavor and high smoke points. The primary fatty acids in the oil are oleic and linoleic (typically 90% unsaturated fatty acids), with the remainder consisting of palmitic and stearic saturated fatty acids. The primary use is as a salad and cooking oil or in margarine.

High oleic sunflower oil (over 80% oleic acid) was developed commercially in 1985 and has higher oxidated stability than conventional oil. It has expanded the application of sunflower oils for frying purposes, tends to enhance shelf life of snacks, and could be used as an ingredient of infant formulas requiring stability.

B. Meal:

Non-dehulled or partly dehulled sunflower meal has been substituted successfully for soybean meal in isonitrogenous (equal protein) diets for ruminant animals, as well as for swine and poultry feeding. Sunflower meal is higher in fiber, has a lower energy value and is lower in lysine but higher in methionine than soybean meal. Protein percentage of sunflower meal ranges from 28% for non-dehulled seeds to 42% for completely dehulled seeds. The color of the meal ranges from grey to black, depending upon extraction processes and degree of dehulling.

C. Industrial Applications:

The price of sunflower oil usually prohibits its widespread use in industry, but there are several applications that have been explored. It has been used in certain paints, varnishes and plastics because of good semidrying properties without color modification associated with oils high in linolenic acid. In Eastern Europe and the former USSR where sunflower oil is plentiful, sunflower oil is used commonly in the manufacture of soaps and detergents. The use of sunflower oil (and other vegetable oils) as a pesticide carrier, and in the production of agrichemicals, surfactants, adhesives, plastics, fabric softeners, lubricants and coatings has been explored. The utility of these applications is usually contingent upon petrochemical feedstock prices.

Sunflower oil contains 93% of the energy of US Number 2 diesel fuel and considerable work has been done to explore the potential of sunflower as an alternate fuel source in diesel engines. Blends of sunflower oil and diesel fuel are expected to have greater potential than the burning of pure vegetable oil.

D. Non-Oilseed:

The use of sunflower seed for birdfeed or in human diets as a snack, has grown consistently over the past 15 years. Varieties used for non-oilseed purposes are characterized by a larger seed size and require slightly different management practices. During processing, seed is divided into 1) larger seed for in-shell roasting, 2) medium for dehulling, and 3) small for birdseed. Standards for different uses vary.

E. Forage:

Sunflower can also be used as a silage crop. It can be used as a double crop after early harvested small grains or vegetables, an emergency crop, or in areas with a season too short to produce mature corn for silage.

Forage yields of sunflower are generally less than corn when a full growing season is available. In one study, sunflower dry matter yields ranged from 2.0 to 3.0 ton/acre compared with 3.1 to 3.8 ton/acre for corn. Moisture content of sunflower at maturity is usually high (80 to 90%) and would require wilting before ensiling.

Nutritional quality of sunflower silage is often higher than corn but lower than alfalfa hay (Table 1). Crude protein level of sunflower silage is similar to grass hay

and higher than corn silage. Generally, crude protein of sunflower decreases and lignin percentage increases after the flowering stage. High plant populations increases fiber and lignin percentage. Seed size does not seem to affect yield or quality.

Table 8: Nutritional quality of sunflower, immature corn, and mature corn silage, alfalfa hay (harvested in early bloom) and timothy bay (harvested in late vegetative stage).

	Silage			Hay	
	Sunflower	Immature corn	Mature corn	Alfalfa	Timothy
	% of dry matter				
Total digestible nutrients	67.0	60.0	69.0	58.0	68.0
Crude protein	11-12	8.2	7.8	18.0	11.4
Ether extract	10-12	2.6	2.9	2.2	2.4
Crude fiber	31.0	31.0	23.0	31.0	31.0
Acid detergent fiber	32.0	---	31.0	38.0	33.0
Lignin	10-16	---	---	9.0	3.1
IVDDM[1]	63-70	---	---	66.0	63.0

1 In vitro dry matter disapperance

III. Growth Habit:

Sunflower is an annual, erect, broadleaf plant with a strong taproot and prolific lateral spread of surface roots. Stems are usually round early in the season, angular and woody later in the season, and normally unbranched.

Sunflower leaves are phototropic and will follow the sun's rays with a lag of 120 behind the sun's azimuth. This property has been shown to increase light interception and possibly photosynthesis.

The sunflower head is not a single flower (as the name implies) but is made up of 1,000 to 2,000 individual flowers joined at a common receptacle. The flowers around the circumference are ligulate ray flowers without stamens or pistils; the remaining flowers are perfect flowers (with stamens and pistils). Anthesis (pollen shedding) begins at the periphery and proceeds to the center of the head. Since many sunflower varieties have a degree of self-incompatibility, pollen movement between plants by insects is important, and bee colonies have generally increased yields.

In temperate regions, sunflower requires approximately 11 days from planting to emergence, 33 days from emergence to head visible, 27 days from head visible to first anther, 8 days from first to last anther, and 30 days from last anther to maturity.

Cultivar differences in maturity are usually associated with changes in vegetative period before the head is visible.

IV. Environment requirements:

A. Climate:

Sunflower is grown in many semi-arid regions of the world from Argentina to Canada and from central Africa into the former Soviet Union. It is tolerant of both low and high temperatures but more tolerant to low temperatures. Sunflower seeds will germinate at 39°F, but temperatures of at least 46 to 50°F are required for satisfactory germination. Seeds are not affected by vernalization (cold) in the early germination stages. Seedlings in the cotyledon stage have survived temperatures down to 23°F. At later stages freezing temperatures may injure the crop. Temperatures less than 28°F are required to kill maturing sunflower plants.

Optimum temperatures for growth are from 70 to 78°F, but a wider range of temperatures (64 to 91°F) show little effect on productivity. Extremely high temperatures have been shown to lower oil percentage, seed fill and germination.

Sunflower is often classified as insensitive to daylength, and photoperiod seems to be unimportant in choosing a planting date or production area in the temperate regions. Oil from northern regions tends to be higher in linoleic acid and has a higher ratio of polyunsaturated to saturated fatty acids than oil produced in southern latitudes.

Sunflower is an inefficient user of water, as measured by the amount of water transpired per gram of plant above-ground dry matter.

Sunflower is not considered highly drought tolerant, but often produces satisfactory results when other crops are damaged during drought. Its extensively branched taproot, penetrating to 6.5 ft, aids the plant during water stress. A critical time for water stress is the period 20 days before and 20 days after flowering. If stress is likely during this period, irrigation will increase yield, oil percentage and test weight, but decrease protein percentage.

B. Soil:

Sunflower will grow in a wide range of soil types from sands to clays. The demands of a sunflower crop on soil macronutrients are not as great as corn, wheat or potato. As with other non-leguminous grain crops, nitrogen is usually the first limiting factor for yield. Medium to high levels of macronutrients are usually required for good plant growth. Sunflower stover contains a large proportion of these elements, which means sunflower is relatively inefficient in the use of these elements. However, most of these nutrients are returned to the soil with the stover.

Sunflower is low in salt tolerance but is somewhat better than fieldbean or soybean in this respect. Corn, wheat, rye and sorghum are rated medium, and sugarbeet and barley are high in salt tolerance.

Good soil drainage is required for sunflower production, but this crop does not differ substantially from other field crops in flooding tolerance.

V. Cultural Practices:

A. Seedbed Preparation:

Many different tillage systems can be used effectively for sunflower production. Conventional systems of seedbed preparation consist of moldboard plowing or chisel plowing to invert residue and several secondary field operations. Conventional systems have been shown to increase the availability and improve the distribution of potassium and nitrogen and to increase the seed zone temperatures. However, the risk of erosion and expense of the several tillage operations has led to greater interest in minimum or ridge tillage systems.

B. Seeding Date:

Sunflower can be planted at a wide range of dates, as most cultivars are earlier in maturity than the length of growing season in most areas. In areas of the world with no winters, sunflower has been planted at any month of the year to obtain satisfactory yields. In northern regions, highest yields and oil percentages are obtained by planting early - as soon after the spring-sown small grain crops as possible.

A later planting date tends to increase the proportion of linoleic acid in sunflower, especially at southern locations. Damage of sunflower heads by insect larvae may be increased by early planting. Test weight tends to decrease with late plantings.

C. Method and Rate of Seeding:

A planting depth of 1 to 3.5 in. allows sunflower seeds to reach available moisture and gives satisfactory stands. Deeper plantings have resulted in reduced stands and yields. If crusting or packing of the soil is expected, with silt loam or clay soils, a shallower planting depth is recommended.

Sunflower row spacing is most often determined by machinery available, which might be 30 or 36 in. for corn, soybean or sorghum growers, or narrower rows for sugarbeet growers. Hence, row spacings can be chosen to fit available equipment. Row spacings of 30 in. are most common. There is evidence that earlier, semidwarf varieties may perform better in narrower rows at high populations.

Plant population has a strong effect on seed size, head size, and percent oil. A medium to high population produces higher oil percentage than does low populations, and the smaller heads dry down faster at higher plant populations.

A lower plant population is critical for maximizing seed size for non-oilseed use.

D. Fertility and Lime Requirements:

Research has shown that sunflower responds to N, P and K. Nitrogen is usually the most common limiting factor for yield. Nitrogen fertilizer tends to reduce oil percentage of the seed, change the amino acid balance, and increase leaf area of the plant. Yield increases from N fertilizer rates up to 175 lb/acre have been observed, but rates considerably lower than this are usually recommended. Nitrogen recommendations in dryer regions can be made from estimates of nitrate nitrogen in the soil, but in wetter regions, this is not feasible. Nitrogen can be supplied from mineral or non-mineral sources (manures, legumes, compost). Row placement of P and K may be important in sunflower for maximizing efficiency of fertilizer use, as it is with many species.

More yield increases are reported as a result of applications of P than from K in Europe and North America.

Sunflower is not highly sensitive to soil pH. The crop is grown commercially on soils ranging in pH from 5.7 to over 8. The optimum depends upon other properties of the soil; no pH is considered optimum for all soil conditions. The 6.0 to 7.2 range may be optimal for many soils.

E. Variety Selection:

The development of a cytoplasmic male-sterile and restorer system for sunflower has enabled seed companies to produce high-quality hybrid seed. Most of these outyield open-pollinated varieties and are higher in percent oil. Performance of varieties tested over several environments is the best basis for selecting sunflower hybrids. The choice should consider yield, oil percentage, maturity, seed size (for non-oilseed markets), and lodging and disease resistance.

F. Weed Control:

As a crop, sunflower yields are reduced, but rarely eliminated by weeds which compete with sunflower for moisture and nutrients and occasionally for light. Sunflower is a strong competitor with weeds, especially for light, but does not cover the ground early enough to prevent weed establishment. Therefore, early season weed control is essential for good yields. Annual weeds have been the primary focus of weed control research. Perennial weeds can also present problems but are usually not specific to sunflower.

Successful weed control should include a combination of cultural and chemical methods. Postemergence cultivation with a coilspring harrow, spike tooth harrow or rotary hoe is possible with as little as 5 to 7% stand loss when sunflowers are at the four to six leaf stage (beyond cotyledon), preferably in dry afternoons when the plants are less turgid. One or two between row cultivations are common after the plants are at least 6 in. tall.

G. Diseases:

The most serious diseases of sunflower are caused by fungi. The major diseases include rust, downy mildew, verticillium wilt, sclerotinia stalk and head rot, phoma black stem and leaf spot. The symptoms of these diseases are given in Table 3. The severity of these disease effects on total crop yield might be ranked: 1) sclerotinia, 2) verticillium, 3) rust (recently more severe), 4) phoma, and 5) downy mildew. Resistance to rust, downy mildew, and verticillium wilt has been incorporated into improved sunflower germplasm.

Table 9: Major sunflower diseases and symptoms.

Downy mildew *Plasmopara halstedi*	Cottony fungus on underside of leaves. Dwarfing, contrasting discoloration of yellow-green and green. Blackening and sometimes swelling at base of stem. Disease most severe when rain occurs before and after emergence.
Powdery mildew *Erysiphe cichoracearum*	Cottony fungus on green leaves late in summer - not largely damaging.
Leaf spot	Dead blotches on flower leaves before heading. Has not

Septoria helianthi	caused appreciable loss.
Verticillium wilt *Sclerotinia sclerotiorum*	Before heading, dead areas along leaf veins, bordered by light yellow-green margins. Decayed vascular tissue in cross-section of stem.
Rust *Puccini helianthi*	Rust colored pustules on leaves, latter black specks on stems.
Sclerotinia head and stem rot *Verticillium dahliae*	Wilt soon after flowering. Light tan band around the stem at soil level. Grey-black sclerotia (size of seed) in rotted heads and stems. Seed and meats discolored.
Phoma black stem *Phoma macdonaldii*	Large chocolate colored blotches on stems at maturity.

H. Insects, Pollinators, and Birds:

Bees are beneficial to sunflower yield because they carry pollen from plant to plant which results in cross pollination. Some sunflower varieties will not produce highest yields unless pollinators are present. All varieties will produce some sterile seed (without meats), but varieties differ in their degree of dependence on insect pollinators. Autogamous sunflower hybrids do not require bees for maximum yield and will yield the same when covered by bags as uncovered. In non-autogamous sunflower varieties, pericarp (bull) development is normal but no ovules or meat develop. Wind is relatively unimportant in cross-pollination of sunflower.

Table 9: Common Insects in Sunflower

Sunflower moth *Homoeosoma electellum*	Eggs are laid at flowering and hatch in 1 week. Larva have dark bands running length of body. Feeds on floral parts, tunnels in Seed.
Banded sunflower moth *Cochylis hospes*	Moth has brown area mid-wing Larvae are not dark striped, smaller than head moth. Makes a small hole in top of seed, feeds on meat.
Sunflower bud moth *Suleima helianthana*	Dark grey moth. Feeds on young stem and head. Headless or damaged heads or large hole on stem near a leaf petiole is symptom.
Sunflower midge *Contarinia schulzi*	Small gnat with tiny cream-colored larvae laid when head is 1" in diameter. Brown spots at base of individual florets or absence of ray flowers, cupping of heads is symptom.
Sunflower headclipping weevil *Haplorynchites aeneus*	Black weevil causes head drop.
Sunflower beetle *Zygogramma exclamationis*	Adult with yellow strips length of wing covers. Humpback yellow larvae causes large areas of defoliation.

Sunflower maggot *Strauzia longipennis*	Adult a yellow fly with dark wing markings, smaller than housefly. Maggots burrow in stem.
Red sunflower seed weevil *Smicronyx fulvus*	Adult is rusty colored, and found in head. Adult female drills egg hole in developing seed and lays egg in hole. Larvae internal to seed; white legless with dark head capsule.
Gray sunflower seed weevil *Smicronyx sordidus*	Adult is gray colored; has behavior similar to red sunflower seed weevil.
Sunflower stem weevil *Cylindrocopturus adspersus*	A robust brown and white spotted snout beetle found on the stem and in leaf axils. Drills egg hole in stem in which it lays its egg. The larva, a white legless larva, burrows in the stem pith. Much more abundant in droughty sites and years.

Birds can be major pests in sunflowers. Especially important are blackbird, goldfinch, dove, grosbeak and sparrow. Many approaches to disruption of feeding have been tried, including scarecrows, fright owls, aluminum strips that flutter in the wind, and carbide exploders. No techniques are 100% effective, as birds will adapt to many of these techniques. However, in many environments, some attempt is wanted. Currently, no chemicals are approved for bird control in sunflower.

VI. Harvesting:

Sunflowers are generally mature long before they are dry enough for combining. Seed maturity occurs when the backs of the heads are yellow, but the fleshy sunflower head takes a long time to dry. Often, there are only a few good combining days in October when the seed is dry enough for storage. Seeds should be below 12% moisture for temporary storage and below 10% for long term storage. Seed up to 15% moisture is satisfactory for temporary storage in freezing weather, but spoilage is likely after a few days of warm weather.

VII. Economics of Production and Markets:

The cost of production and return over variable costs for sunflower is similar to that for small grains. The culture of sunflower and growing season requirements makes them a good niche in cropping systems where small grains are the predominant crops. Markets are generally available in most areas where sunflower has been traditionally grown. However, if a grower considers sunflower as an alternative crop, marketing opportunities should be pursued prior to making the decision to grow sunflower, particularly for non-oilseed varieties.

Questions and tasks for comprehension.

1. What kinds of oilseeds do you know?
2. When and where was sunflower originated?
3. How can we use sunflower?
4. What do you know about sunflower oil?
5. In what way can environment requirements influence the sunflower oil quality?

6. What must any agronomist know while planting sunflower seeds?
7. What is the best way of weed control?
8. What diseases and insects can be dreadful for sunflower-yield?
9. What is the best sunflower maturity time for harvesting?

Task 1. Give general morphological characteristics of sunflower. Use the following words and expressions: annual, insensitive to daylength, low in salt tolerance, broadleaf plant, not sensitive to soil pH, erect, an alternative crop, a strong taproot.

Task 2. Record information from the Nutrition Facts of the vital oils in the spaces provided. Then answer the questions following the table.

A) Sunflower oil – contains about 40% oil, a good source of calcium, protein, vitamins B_1 and B_6, and potassium. Sunflower oil is very high in polyunsaturates. The natural oil also contains relatively high levels of vitamin E (27 mg per 100 ml).

B) Soybean oil – an excellent source of vitamin E (87 mg per 100 ml) and contains more lecithin than any other vegetable oil, one of the very best sources of vegetable protein.

C) Groundnut oil – is highly nutritions and valuable quantities of iron and vitamin B (niacin). Peanuts are a source of vitamin E (21 mg per 100 ml).

The vital oils comparison.

Nutrition information			
Oil A		Oil B	Oil C
Polyunsaturated acids: Total oil: Protein:			
Value of oils			
	Oil A	Oil B	Oil C
Vitamin E Vitamin B (B_1, B_6) Iron: Calcium: Other nutrients:			

1. Which oil is the lowest in fat?
2. Which oil is the highest in vitamins and other nutrients?
3. Which oil would you rank as most nutritious over all? Explain your answer.

Task 3. *Sum up:*

1. Sunflower oil is the most the most popular oil. Prove it.

2. Ukrainian soils and climatic conditions are good for sunflower growing. Try to explain it.

Supplementary Reading

Sunflower oil

Ukraine is one of the principal sunflower oil-producing countries. Sunflower oil is light slightly sweet. It is extracted from the sunflower seeds as soon as they have fully ripened and turned black.

The seeds contain about 40 per cent oil and are also delicious eaten raw. Besides making a nourishing snack, they also are a good source of calcium, proteine, vitamins B_1 and B_6, and potassium.

Sunflower oil is very high in polyunsaturates and, when unrefined, contains useful amounts of Omega-6 EF As. The natural oil also contains relatively high levels of vitamin E (27mg per 100ml).

The oil is the best used cold or at low temperatures as it breaks down and produces toxic elements when heated to high temperatures. It should be stored in the fridge.

Corn oil

Corn or maize oil is high in polyunsaturates and is one of the cheapest, most commonly used oils for cooking.

Corn oil comes from the corn-on-the-cob plant and is extracted from the sweetcorn kernels.

Most corn comes from the U.S. and southern France, where it is usually heavily refined for blended cooking oils.

However, it is possible to find pure, unrefined versions in health food shops.

Unrefined corn oil contains useful levels of the natural anti-oxidant vitamin E (66mg per 100g). Being polyunsaturated oil, it is a good source of the Omega-6 essential fatty acids.

Corn oil deteriorates when heated to high temperatures, so is best kept for recipes that use it cold or warm, such as sauces. It needs protecting from heat, light and exposure to the air.

Buy in small quantities so you use it up faster, and store in the fridge.

Inexpensive dressings can be made using corn oil as a base with small quantities of the more expensive nut oils added for flavour.

Soybean oil

Soybean oil is a relative newcomer to the cooking oil market, although it has along culinary history.

The oil comes from the soya plant, which belongs to the pea or legume family.

The oil is extracted from smooth egg-shaped beans which are usually yellow but may be black or green. When unrefined, soybean oil is an excellent source of vitamin E (87mg per 100ml) and contains more lecithin than any other vegetable oil. As with rapeseed oil, soybean oil has a high smoke point, but should not be used for frying.

The reasons why soybean oil is so nutritious stem from the intriguing soya bean itself. The soya bean must be the world's most nutritious and versatile source of food, and in China it is nicknamed "meat without bones".

Not only do they have a commercially viable oil content, but they are also one of the very best sources of vegetable protein.

Soya beans are used widely in vegetarian and macrobiotic cookery and can be processed to create several different types of food. Soya beans can be coagulated with nigami paste (a calcium suspension) to make tofu. This is a solid curd-type cheese with a multitude of sweet and savoury uses.

Tofu is a wonderful high-protein, low-cost and low-kilojoule food, available in health food stores.

Soya beans also can be crushed and blended with water to make soya milk. A light, nutty liquid, this is good for vegans or those with lactose intolerance and can be used in place of cow's milk.

Olive oil

Olive oil is long-lasting as it forms fewer of the degenerating peroxides that cause rancidity when exposed to heat or daylight.

Olive oil also produces fewer of the dangerous peroxides and aldehydes that have toxic effects in the body. So for those who still insist on the occasional fry-up, use olive oil, as its chemical structure remains the most stable at high temperatures. In cooking terms, olive oil has the fewest number of negative factors and the greatest number of health-giving properties.

The link between olive oil and heart disease was first discovered by scientists at the University of Minnesota who undertook an extensive study into the worldwide numbers of deaths from heart disease. They discovered that the death rates were lowest among those whose main source of dietary fat is olive oil.

One of the lowest incidences of heart disease is in Crete, where the oil flows like wine and the people receive up to half their kilojoule intake from olive oil alone.

Olive oil has traditionally been used for stomach disorders and we now know that it stimulates bile production and will encourage the gall bladder to contract, reducing the risk of gall stones.

It also promotes pancreatic secretions and may even protect against stomach ulcers.

A guide to cooking oils

Pure, unrefined cooking oils are more expensive than the processed blends, but they taste far better and contain many important nutrients such as vitamin E and lecithin.

All unrefined oils have their own natural flavours and you can play around with the different varieties to suit your tastebuds.

Our daily bread

Bread is food we all enjoy and like to it daily. It tastes delicious, it's convenient and it's good for us.

We could eat a different bread every day for a month, for there is an amazing variety of breads to choose from.

There rye and black breads, bread sticks, flat breads, white bread wholemeal and mixed grain breads. And they come myriad shapes: round plump cottage loaves, long bread sticks, squares, rolls, crisp breads, tank loaves – and that's just the beginning.

Bread is one of man's oldest convenience foods and is still acclaimed for its versatility and economy. It's important to recognise that bread makes an important and nutritious contribution to our diet. Vary the types of the bread you buy, enjoy them fresh and any leftover can be used in wonderful soups, puddings, salads and snacks.

Every country that considers bread an essential part of its life and wellbeing has developed ingenious ways of using leftover bread and has created dishes that can star in their own right. There's double value in knowing that, as well as providing dishes you and your family will enjoy, bread helps to build healthier bodies.

Pot them up

Herbs must be the most versatile of all the plants we can grow.

As well as providing the cook with an assortment of tasty flavourings, many are also very attractive. In addition, they are usually very easy to grow.

What could be better than that?

Although herbs will grow well in the borders, alongside other purely decorative plants.

Herbs, in general, grow best in well-drained conditions. If your garden soil is on the heavy side, you'll be more successful with container-grown plants.

Pot-grown herbs can be moved about the garden as required. Plants for cooking can be placed near the door; decorative ones will look well on a patio.

Pots are also ideal for keeping some of the more rampant herbs under control. Many mints have attractive foliage, but they spread quickly and their roots will soon become entangled with other plants.

Containers should be at least ten inches in diameter. Any smaller and they'll dry out too quickly.

For a decorative display, select pots of varying sizes and shapes. If you use terracotta containers, remember they won't retain moisture as well as plastic ones. In summer, they may have to be watered daily.

Plants That Bolt

Even experienced gardeners suffer setbacks!

If a vegetable crop is put under stress, it may start to "bolt" or run to seed, before it can be harvested. For example a sudden cold snap at a critical stage in their growth will prompt the plants to produce flower stalks several weeks later.

Early varieties are more likely to bolt than later ones. If there is a cold spell in late spring, young plants, which are already growing away quite strongly, can often suffer this sort of stressful check.

Plants raised inside under protection are also more susceptible than those sown directly outside. When the temperature falls steeply soon after they have been transplanted, they can later react by bolting.

Obviously it helps if plants can be protected when the weather turns chilly. Cloches are ideal – or a covering of horticultural fleece.

Later in the year, the same thing will happen if the plants suffer a severe shortage of water. If they feel their growth is threatened, their natural reaction is to try to reproduce themselves – they set seed so the species will survive.

So how can you prevent a row of flower stalks shooting up from your favourite vegetables? Beetroot, celery, lettuces, onions, spinach and brassicas will all bolt easily.

The answer is quite simple. Make sure they are never short of water. And, remember, a mulch over the soil will help conserve the precious moisture.

Such An Easy Crop

Some vegetables need a lot of attention all during their growing period. It helps to balance things out if you also grow some which are easy to care for …

One of the least demanding must be the shallot. It's hardy and can be planted early in the year, and then left to grow on with little attention until it's harvested in midsummer.

The shallot is a close relative of the onion, but the small bulbs are produced in clumps and have a milder flavour. They're often used for pickling, but are tasty when grated into salads. Harvested early, they can also be used as spring onions.

Never set shallot bulbs into ground which has been freshly manured. They're best planted where there was a well-manured crop last year. This should provide sufficient nourishment for their needs.

Like onions, they need a well firmed soil. First rake the ground over and then tread it down by shuffling over it several times.

Usually the bulbs are just pressed into the soil to about half of their depth. But, if the soil has been properly firmed, the base of the bulbs can be bruised and they'll be more likely to push themselves out of the ground as the roots start to develop.

I prefer to make a small hole with the point of a trowel. Then I set in each bulb so the shoulder is almost covered with soil. There should be about nine inches between each bulb, with a foot between the rows.

Apart from regular weeding, the growing shallots should need no other attention.

Once the leaves begin to turn yellow and wither, the bulbs can be harvested.

Dry them off thoroughly in the sun for several days and then store for winter use.

Martian vegetables

Earthlings, prepare to be amazed: New Zealand scientist Michael Mautner at Lincoln University has grown the world's first Martian vegetables! The tiny asparagus and potato plants didn't arrive on a spaceship. They were grown successfully in Martian soil, here on Earth.

How did Mautner get soil from Mars? He made it by grinding up slices of two Martian meteorites that had landed on Earth from the Red Planet. One was found in the Sahara Desert, the other in Antarctica.

Mautner mixed ground-up rock with water and put tiny bits of asparagus and potato plants into the mixture. And the plants started to grow!

"It was exciting to see the vegetables grow so well in Martian soil," Mautner says. "In the future, people starting a colony on Mars could use the soil there to grow food."

Lawnmakers

A tidy lawn gives the finishing touch to a garden. If you have a new block to landscape, choose the lawn area carefully.

Lawns need at least five to six hours of sunshine daily, and it would be an advantage if they can receive more. It is almost impossible to get lawn grass to grow in heavily shaded areas and under large trees, although there are some lawn mixes that will grow in moderately shady areas.

Buy seed mixes that have been blended and recommended for the areas where you wish to establish a lawn.

Site preparation is vital, so do not rush into planting a new lawn. Even if it takes six months to get the area ready, the quality of the lawn will be worth the wait.

Some people like to grow potatoes in the area first, to improve soil structure, and many weeds can be removed before the lawn is sown.

Soils containing a lot of clay can be improved by using gypsum at the rate of 300g to a square metre.

Acidic soils can be improved with lime, adding about 130g to a square metre. Spread lime on a calm day and wear protective clothing.

Other materials that can be worked into heavy soil to improve structure include compost, manure, coarse sand or aged, untreated sawdust.

If new soil has to be brought in, do not spread it over the existing soil. Mix it into the existing soil with a rotary hoe.

The more times you can hoe the area before planting, the better the lawn will be. Also, organic materials can be worked into sandy type soil.

Make six weeks the minimum of time for soil preparation.

Rake the area to a good level before planting.

If fertilizer has been added to the lawn seed, you won't need to add any more before the final raking.

Prepared lawn fertilizers are available and quantities to use will be given on the containers.

Lawns can be planted during the spring and early summer or, in areas where water is limited, autumn planting may be better.

Seed mixes differ, so be guided by the instructions to achieve the right thickness.

There is no need to cover the lawn seed with soil, but a light roller can be used to bed the seed firmly or you can walk across it with close footsteps. The latter method is good on slopes if it rains before germination, as the seed will remain more easily in those footmarks, instead of washing to the bottom of the slope.

Water with a fine spray and keep the area moist to achieve a quicker, more even germination.

Let the new grass grow to a height of 8cm before making the first cut. And cut initially with the mower at its highest notch, and then lower the blades at each mowing until you reach the desired height.

During hot weather, do not mows too low or the roots may burn.

If the lawn tends to yellow, it could be lacking food. Apply a lawn fertilizer to moist soil and water immediately.

When laying instant lawn turf, the soil preparation is the same as for lawn seed. Avoid walking over instant lawn for a few weeks.

Gardening Terms

Blanching The process of covering the stems of plants to make them sweet.
Bolting The is term used to describe the habit of some vegetables which produce leaves or roots for eating producing flower heads instead very early in the season. This is usually caused by hot dry weather, and the edible parts of the crop become unusable. Particularly subject to this are spinach, lettuce, and beetroot.
Brassicas A particular family of vegetables. This includes cabbage, cauliflower, kale, radish, broccoli, calabrese, Brussels sprouts.
Catch crops These are fast maturing crops which can be sown between crops which will take up a lot of space later in their development – radishes or lettuces between newly planted rows or sprouts or potatoes, for instance.
Cloches Derived from the French word for bell; the French originally put bell shaped domes of glass over crops to bring them along early. Modern cloches are generally tunnel shaped, and polythene or one of its variants are more usually used than glass.
Compost There can be confusion here. Garden compost is made from kitchen and garden refuse, allowed to rot down and dug into the soil to break it up and provide additional nutrition. Branded packs of seed, cutting and potting proprietary mixes are usually also called compost, but tend to be based mainly on peat.
Double digging Hard work, but necessary where ground is being brought under cultivation for the first time. Soil is taken out of a trench the length of the vegetable patch to a depth of two spades; this is carried to the far end of the plot. Then a second trench is dug, its soil going into the first trench, and so on until soil from the first trench fills the last trench of all on the plot.
Drills The very shallow trenches in which seeds are sown. When the soil has been raked to give a fine surface with no clods in, the back of a rake is usually used in conjunction with a garden line to make an even shallow indentation for the seeds to go in. It is covered afte4rwards by raking.
Earthing up This is a name given to the habit of drawing soil up around a growing plant to increase the crop, as for potatoes, or to blanch the stems, as with leeks and celery.
Forcing This is a production of crops out of their normal season and habits. It is usually done in darkness.
Germination The start into growth of seeds, when they receive the appropriate amounts of warmth and moisture.
Hardening off Indoor raised plants should not be transferred direct from greenhouse to open ground, as they will receive a severe setback to growth this way, and may not be sufficiently hardy to survive. Hardening off is usually done in a cold frame, and the young plants are exposed to a little more of the normal outdoor temperature each day, until in the end they are only covered on the coldest night. After this process, they are strong enough to go in the open ground, although they are occasionally planted under cloches first.
Humus This is a name given to broken down organic materials, which contain living organisms which provide nutrition from within the soil.
Legumes This name is given to the pea and bean families.

Lifting The harvesting of root vegetables. Always be careful to press the fork into the soil at a considerable distance from the plant, so that there will be no danger of sticking the tines through the edible part of the vegetable.

Lights The name traditionally given to the removable top part of a cold frame.

Mulching The provision of moisture holding material around plants. It serves two purposes; one is to keep down weeds as the material is generally impenetrable, and the other is to maintain moisture supplies in the soil. Always water the ground before applying a mulch.

pH This is a measure of hydrogen ion concentration in the soil, which is responsible for the soil's degree of acidity or alkalinity.

Potting on This is an intermediate stage in the life of a plant. A tomato, for instance, is first put in a 8 cm/3in pot. After it has been in this a few weeks, tap it out and see whether the roots are covering the outside of the soil ball. If they are, it is time to pot on. Fill the next size pot with enough soil so that when the plant with its complete rootball and cling8ing soil stands in the new pot, its soil level is about 1 cm/1/2 in below the rim. Then gently add soil around the edges, firm it, and water.

Rotation The principle of only growing the same family of vegetables in the same patch of ground every three or four years. This reduces the risk of soil borne diseases particular to one family establishing themselves, and gives the soil a chance to recover from the particular nutrient deficiency a particular crop will have caused.

Seed bed This is an area set aside for raising young plants of vegetables which need to be transplanted later. These include cabbages, cauliflowers, sprouts, broccoli, kale and leeks. The seed bed should be very finely raked and cultivated, and should if possible be sited near a frame or greenhouse.

Succession The practice of sowing small quantities of a crop at regular intervals so that there is always something fresh to eat from the garden, rather than sow everything at once which will mean freezing or giving away produce at harvest time.

Tilth The finely broken down surface of an area where seeds are to be sown.

Transplanting This is careful digging up, with soil attached, of the young plants mentioned under Seed beds, and their planting in their final positions where they will remain until harvest. Transplanting should ideally be done in showery weather so that there will be less risk of the young plants wilting.

Reference section
Pests and diseases

aphid	попелиця
black leg	чорна ніжка
blight	хвороба рослин, яка характеризується зав'яданням, гниттям або припиненням росту
carrot fly	муха маркова
clubroot	піна хрестоцвітих (збудник слизистий гриб Plasmodiophora brassical)
downy mildew	несправжня волошниста роса (збудники гриби Psilarosae)
eelworm	нематода Heterodera
gray mold	сіра пліснява (збудник гриб Botrytis cinerea)
larva	личинка, гусінь
leaf scorch	покриття листка чешуєю
maggot	личинка комах
phoma black stem	чорна ніжка, плямистість стеблів (збудники гриби)
potato blight	рання гниль картоплі
rot	гниль
rust	іржа (збудник іржавий гриб)
scab	парша
slug	слизень
smut	сашка (збудники сашкові гриби Ustilaginales)
sunflower midge	галиця (дрібна двокрила комаха)
sunflower moth	огнівка соняшникова (Homoeosoma electellum)
wart	наріст, наплив (на рослині)
woollybear	волосата гусінь

Vocabulary

A

adhesive	липкий, клейкий
anthesis	цвітіння, запилення
autogamous	автогамний, аутогамний

B

biennial	дворічна рослина
blackbird	чорний дрізд
blotch	плямистість (плодів, листя)
bruis	ушкодження
bulk	велика кількість
byproduct	побічний продукт

C

calcareous	вапняний
chisel	долото, зубило
circumference	периферія
cloche	вид тепличної рослини
clove	гвоздика (пряність), гвоздичне дерево, цибулинка
coarse	грубий, низького сорту
copiously	рясна, буйно, широко
cotyledon	сім'ядоля
crude	сирий (загальний) білок
curvilinear	криволінійний

D

deficiency	недостача, відсутність (чого-небудь)
dehull	лушпайка
detergent	детергент, очищувальний засіб
deteriorate	погіршувати, псувати
dibber	прилад, що робить ямки, саджальний кіл
dill	кріп
DM – dry matter	суха речовина
dormancy	спокій (рослин, насінин)
drill	борозна, (рядова) сіялка, сіяти, саджати рядами
dwarf	карликова рядова пшениця

E

eaves	похил даху
ensiling	силосування
eradicate	виривати з корінням
erect	прямостоячий, вертикальний

F

foliage	листя
freckle	плямочка, крапка
fungus	гриб, грибок.

G

gable	коньок даху
garden riddle	садове решето, сито

garlic	часник
glum	колоскова луска, полівка
gluten	клейковина
gnat	комар
goldfinch	щиголь
grit	пісок, гравіт
grosbeak	звичайний дубоніс, товстоніс
grub	черв'якоподібна личинка, викопувати
gutter	водостічний жолоб, стічна канава
H	
hardpan	твердий підгрунтовий шар
haulm	стебло, бадилля
heap	куча, купа
hoe	мотика
horseradish	хрін звичайний
humpback	горб
I	
in vitro	"у склі", у пробірці
inadvertently	недбало, несподівано
inert	нейтральний, в'ялий
K	
K	калій
kale	капуста
kerner	зерно, зернятко
kiln	сумарня
kit	комплект інструментів
knobbly	зернистий, дрібнозернистий
L	
lag	затримка, зрушення фраз, захований час
leaf mould	листова пліснява
lean – to	прибудова з односкатним дахом, навіс
leavened bread	дріжджовий гриб
lime	вапно
M	
meat	м'якоть (плода)
mesh	отвір, чарунка
mold	пліснява, пліснявий гриб, перегній, гнити, розкладатися
mulch	підстилка у трав'янистих формаціях
N	
niche	ніша
nodule	вузол, бульба
P	
P	фосфор
parsley	петрушка
patch	невелика ділянка ґрунту

peat	торф
pebble	горошок посівний
perennial weed	багатолітній бур’ян
pick	кирка
pickaxe	киркомотига, розпушувати
pistil	маточка
plumpness	виконаність (про порожнину зерна)
potash	поташ, вуглекислий калій
puddle	калюжа
R	
rachis	вісь складного колосу, головна вісь квітконосного пагону
rot	гниття, гниль
rotavator	ротаватор
rubber stopper	гумова пробка
rubble	бут, валун
S	
scab	кірка, струп, парша (збудники гриби або бактерії)
sifting	просіювання ґрунту
soak	вбирати, всмоктувати, проникнівість
soakaway	поглинаючий колодязь
sorrel	щавель
spadeful	повна лопата
span –roofed house	будинок з перекритим дахом
sparrow	горобець
spike	вістря, колючка, колос
spikelet	колосок,
spirit level	спиртовий рівень, ватерпас
splitting	розщеплення
sprout	пагін
stamen	тичинка
starchy	крохмалистий
surfactant	сурфактант
T	
taproot	стрижневе коріння
tilth	обробка ґрунту, глибина обробки шару
trial	досвід, випробний
trowel	садовий совок
U	
utmost	крайній, віддалений
V	
vigor	сила, потужність, енергія
W	
wheelbarrow	тачка
wilting	в’янення, похилення

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