Leaving Certificate

Agricultural Science

Cereals- Barley

Learning Outcomes

- Family
- Certified seeds
- Soils and Climate
- Place in rotation
- Varieties.
- Seed Bed Preparation
- Sowing
- Fertiliser
- Lodging.
- Tillering
- Pest, Disease and Weed Control.
- Harvesting
- Yield.

Cereals

Cereals

- Cereals are members of the **monocot** family and Order **Gramineae.**
- They are
  - grown and cultivated for the edible components of their seeds.
  - Provide more food energy than any other type of crop.
  - staple crops; a food that can be stored for use throughout the year or produced fresh any time of the year and forms the basis of a traditional diet.
- In their natural form (whole grain) they are a rich source of carbohydrate, vitamins, minerals, fats oils and protein.

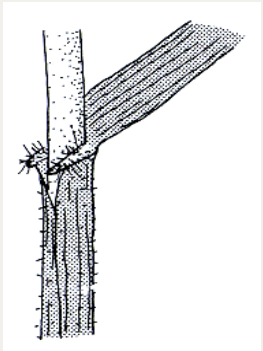
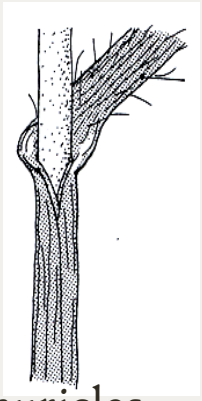
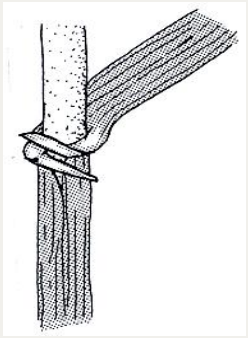
Barley

- Barley is a member of the *Order Gramineae*, the most important order as far as agriculture is concerned.
- Barley as a crop in Ireland has increased its importance in the last 30 years.
- The amount of Barley grown fluctuated for many years but at present the amount of land under barley is increasing.
- This is due in part to the declining importance of oats as a feed for the working horse.

Barley

- Barley is the fourth most commonly grown cereal in the world. It is used as **feeding barley** and for **malting**.
- The quality of malting barley must be higher than that of feeding barley so more care, skill and experience is required when growing it.
- Malting barley is usually grown on contract to the large breweries and distilleries.

Cereal Identification

Wheat	Oats	Barley
		
 Wee Hairy auricles	 O auricles	 Big Long auricles

Geographical Location of Crop

- Depends on
  - Sunshine
  - Rainfall
  - Topography
  - Proximity to markets

Soils & Climate

- The crop we are most concerned with is Barley (Hordium).
- The best soils for malting barley are medium loams.
- The best soils needed to grow this crop is either Grey Brown Podzolics or Brown Earths; deep sandy loam soils that have good drainage with a pH of 6.5.
- Grown in Wexford and Louth (on brown Earths) and the midlands (on Grey Brown Podzolics) .
- Lime may need to be added if the soil is too acidic.
- Barley does however give higher yields when grown in rotation.

Soils & Climate

- When growing after a ley, pests can be a problem, and best results come in the second year of growing. Leatherjacket
- After a root crop the soil can become quite compacted and more cultivation may be required.
- Barley requires a steady supply of moisture during growing season.
- Drought in mid-season reduces Yield & Quality
- Dry soil conditions during ripening & at harvesting is important.
- Because of this its growth is restricted. Most of its production is confined to the eastern side of the country.

Types of Barley

- There are two types that are grown in Ireland, feeding barley and malting barley.
- The average yield at the moment in Ireland per hectare is about 6 tonnes.
- Feeding Barley and Malting Barley differ in the type of soil that they require but both need a steady supply of moisture over the season.

Feeding Barley

- Feeding barley is suitable for all livestock.
- About a third of the crop is usually retained by the farmer and the rest is sold to be made into animal rations.
- Barley straw can be fed but has a low feeding value.
- Feeding Barley will grow on a wide range of soils as long as it has good drainage and a PH greater than 6.0.
- Grown for on farm feeding or for Compounders: O'Connor, Roches, Liffey Mills.

Malting Barley

Malting Barley

- Malting Barley is used in the brewing and distilling industries (grown on contract for Guinness & Murphy).
- It is grown only on very good soils: with the clay rich grey-brown podzolic soil being the best as it retains moisture for proper ripening but the crop also requires dry soil conditions in Summer for harvest.
- It is confined mainly to South Dublin, Meath, Kilkenny, Carlow and Cork.
- The soil for this crop is usually a medium loam with a pH of 6.5 to 7.5.

Malting Barley

- It outperforms yields of Spring barley by about 25%.
- It cannot be fertilized using split dressings as this gives rise to high N levels in the grain and they cannot therefore be malted.
- Barley may be sown in Winter or Spring but farmers tend to sow as much land as possible with Winter varieties and then fill the rest with Spring crops.
- The seedbed should be fine but not too fine as this can lead to it being too moist after sowing.
- Rolling shouldn't be carried out as this can lead to the soil becoming 'capped' if there is heavy rainfall.

Spring Barley Varieties

- All are two row varieties.
- For feeding barley the most commonly sown varieties are Triumph, Fleet, Klaxon & Beatrice.
- For malting barley Triumph, Grit and Emma are common varieties.
- Not fully frost resistant
- Sown in Spring
- Shorter growing season and lower yield
- Harvested from August onwards

Winter Barley Varieties

- Winter barley can be either two or six row varieties (four row no longer being used).
- Igri and Panda are well known two row varieties sown in the winter.
- They make up 98% of all Winter barley sown.
- Gerbel, Jaidor and Olympic are example of six row varieties sown in the Winter.

Winter Barley Varieties

- Sown form mid-September to early November
- Can survive winter frosts
- Reach grass corn stage (8-10cm) before Winter
- Longer growing season and greater yield
- Harvested mid-July onwards

Advantages of Winter varieties over Spring

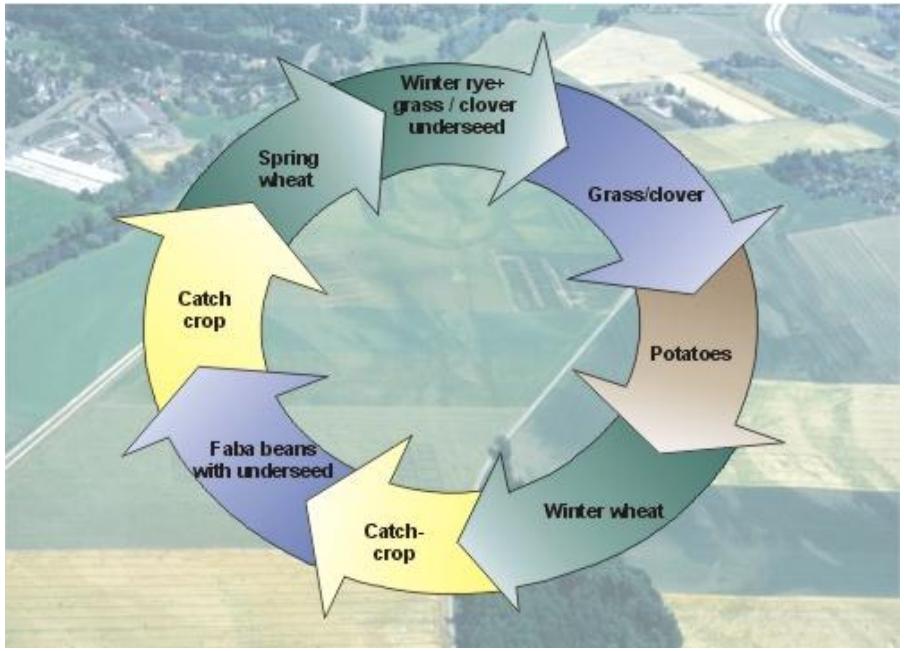
- They obtain on average 20% more grain than Spring crops.
- Earlier ripening allows harvesting in good weather and firm soil conditions.
- Bad Spring weather delays cultivation and sowing thus reducing yield.
- Spring barley relies on good weather and over reliance on this type can be disastrous in bad years.

Advantages of Winter varieties over Spring

- On mixed farms Winter barley varieties reduce labour during Spring (calving and lambing)
- If you sow in the Spring you may not be able to get the equipment you need. In the Winter the equipment would be idle.
- But when sowing Winter barley you require more seed and more cultivation work.

Place in Rotation

- Grass break every 3 years to avoid the build up of soil borne pests
- Rotation also reduces weeds- different sowing dates, crop competition & shading.



Seeds

- Should be of high germination capacity.
- Free from seed borne diseases.
- Free from weed seeds (Wild oats)
- True to name.
- Protected against wireworm and fungal diseases.
- When using your own seed you should avail of the free seed testing service from the Dep. of Agriculture.

Certified Seeds

- Most seed sown for any crop in Ireland is certified seed produced by the Department of Agriculture.

- It has to meet certain requirements.
  - Minimum germination rate of 85%
  - Minimum analytical purity of 98%
  - Completely free from ‘Wild oats’ (*Avena fatua*)
  - Seed is treated with fungicide/insecticide.

Certified Seeds

- The ‘Recommended List of Cereal Varieties’ is published every year which contains seeds that have been tested over three year periods.
- Barley with improved characteristics is printed every year so the type of barley changes over a period of time.
- Treated with fungicide & insecticide (dressed in pink coat)
- Tested for 3 years by government. Dept. of Agriculture

Varieties

- The varieties of seed are being continuously tested by Teagasc for a number of characteristics
  - (a) Yielding Capacity
  - (b) Shortness of Straw
  - (c) Strength of Straw
  - (d) Earliness of ripening
  - (e) Resistance to disease
  - (f) Free from wild oats

- With certified Seed it is recommended that it is dressed.
- This is a cocktail of Organo-Mercurial compounds, which protect against fungal and pest attack.
- The seed has a pink coat (covering) if this is done.

AGRONOMIC & QUALITY CHARACTERISTICS*	Recommended				Previously Recommended
	CAMION	**SAFFRON**	**SPECTRUM**	**AMARENA**	**BOOST**
Relative Yield ♦	**99**	**102**	**99**	**105**	**106**
Shortness of straw	6	6	7	5	5
Strength of straw	6	7	7	7	(7)
Earliness of ripening	6	5	6	6	(7)
Resistance to:					
Mildew	5	4	5	7	(6)
Rhynchosporium	5	5	5	6	(6)
Brown Rust	5	6	5	7	(4)
Net Blotch	7	7	6	7	(7)
Grain quality:					
1000 grain weight (g)	53.5	56.7	57.7	47.2	47.5
Hectolitre weight (kg/hl)	68.7	68.4	65.8	62.1	65.6
Year First Listed	**2005**	**2007**	**2005**	**2008**	**2009**

Seed Bed Cultivation

- It should be fine, friable, well aerated, well drained, well settled, limed the previous year and preferably autumn ploughed.
- It should not be spongy.
- Sometimes it is difficult to sow barley after potatoes or sugar beet.
- Deep ploughing is not necessary and the seed should be drilled no deeper than 5cm. P & K fertiliser are applied at sowing time only.
- To achieve this seedbed the following cultivations are done.
  - Plough,
  - Rotovate,
  - Disc Harrow,
  - Seed,
  - Chain Harrow,
  - Roll
- Often a “One Pass” machine is used to decrease the amount of machinery used and compaction of the soil.
- Soil should be at Field Capacity. N can be applied as a top dressing when it is required.
- Winter barley – not so fine seed bed as soil is moist after sowing- should not be rolled as it causes soil capping if it rains.

Sowing Rates

- For Spring barley the rates should be 125 – 155 kg / ha depending on the variety and size of grain.
- For Winter barley the seeding rates are higher but recent experiments have shown that there is little difference between high and low seeding rates because of tillering. ~ 200kg/Ha.
- If it is sown too quickly there will be problems with Eye Spot.

Sowing Rates

- The rate is kept low because these crops can tiller naturally, so one plant can produce 3-4 seed heads.
    - 250/300 plants should establish themselves per m^2.
    - 900/1000 ears at harvesting due to tillering per m^2.
- Rates have reduced over the last number of years because of better understanding of tillering and genetic engineering.
- Lower rates give strong straw, less lodging (falling over straw) and a reduced risk of eyespot disease.

Sowing Time

- The ideal time for winter barley is the second half of September preferably October 1st (but can be sown up to November depending on the weather.)
- If sown before this date the crop grows past grass corn stage before Winter. It will be too tall when growth begins the following Spring – lodging
- If sown too long after Oct 1st it will not reach grass corn stage before Winter- lowers yield

Sowing Time

- Spring barley should be sown early February depending on the weather.
- Spring barley should be sown as early as weather permits- late sowing reduces yield
- Sown using a combine drill- this drills in seed & fertilizer adjacent to each other 18cm apart

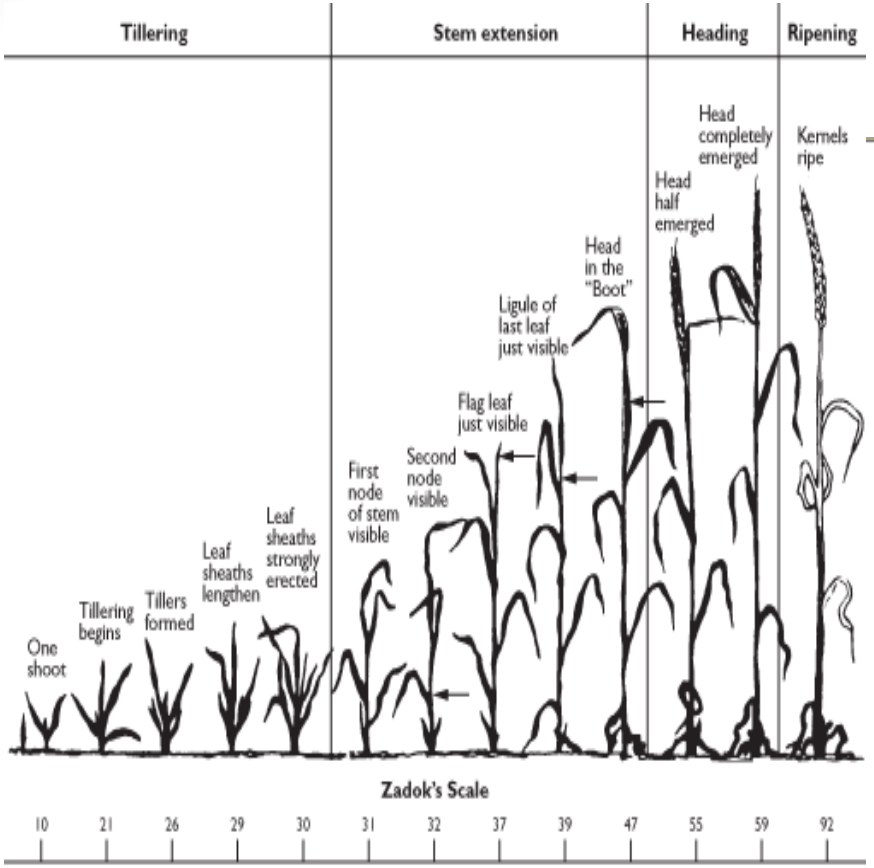

RFM

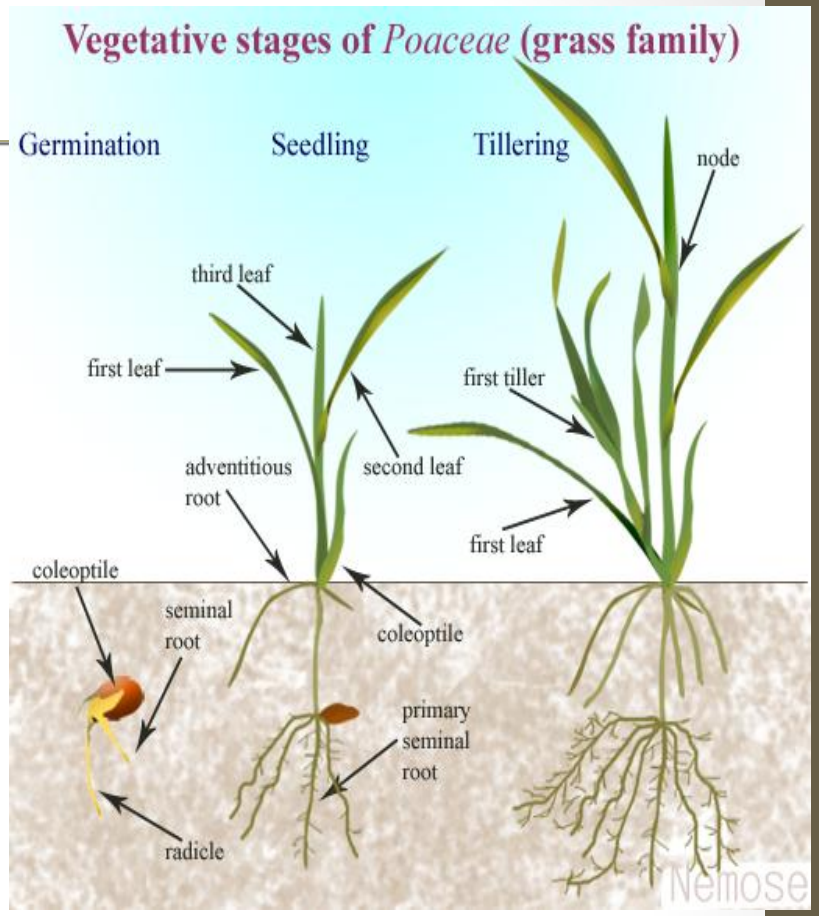

roger

Combine Drill

Tillering

- Tillering is the ability of cereals and grasses to form auxiliary or side shoots from the main shoot.
- The main shoot produces a number of side roots/tillers, each of which develops its own root system & grows into a mature plant while still attached to the main root.
- These grasses have short stems but can develop flowering shoots.
- Tillering can be enhanced by a series of shocks to the plant such as frost or sheep grazing.
- Additional Phosphorous also initiates tillering.


Tillering
Stem extension
Heading
Ripening
One shoot
Tillering begins
Tillers formed
Leaf sheaths lengthen
Leaf sheaths strongly erected
First node of stem visible
Second node visible
Flag leaf just visible
Ligule of last leaf just visible
Head in the "Boot"
Head half emerged
Head completely emerged
Kernels ripe
Zadok's Scale
10 21 26 29 30 31 32 37 39 47 55 59 92

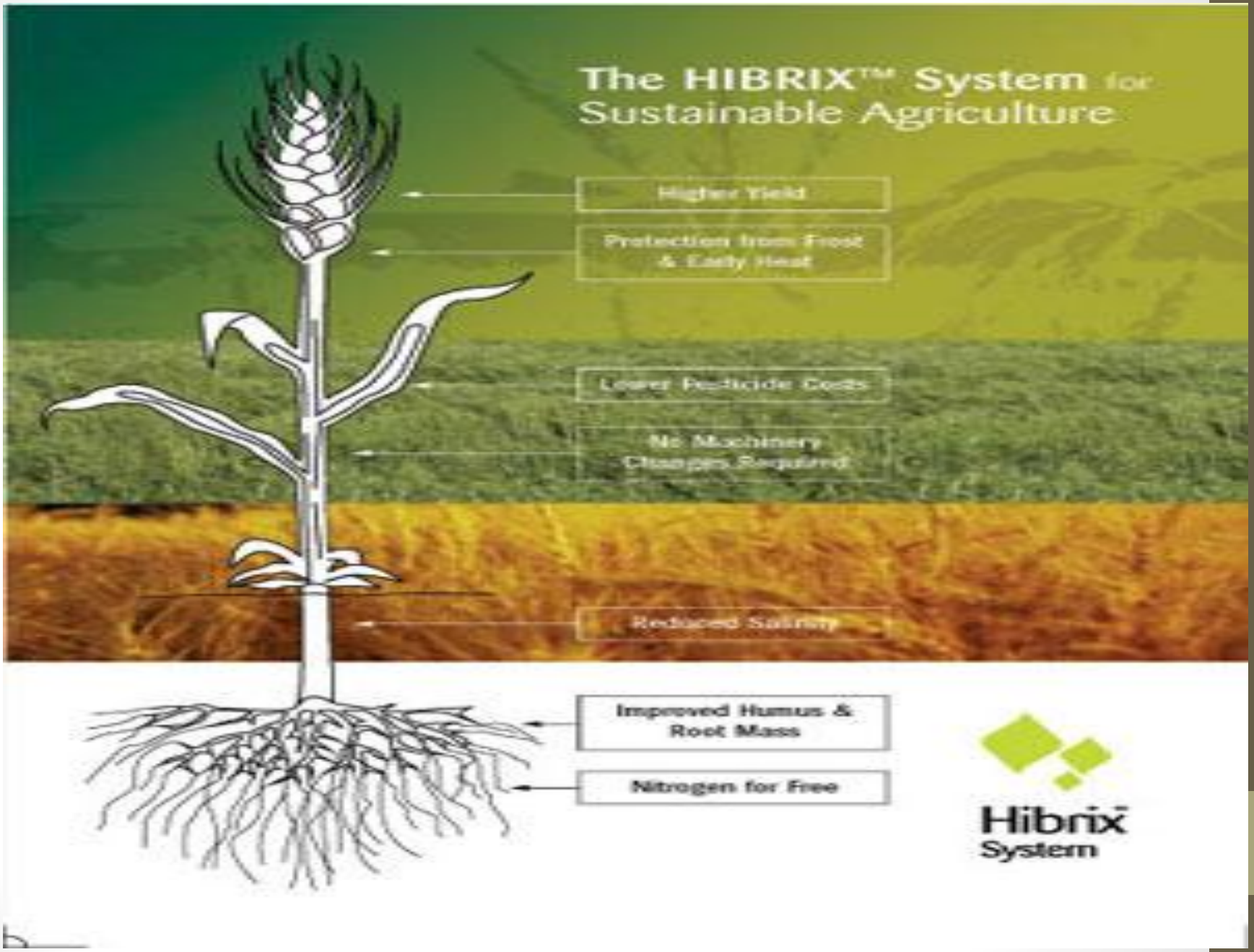

Vegetative stages of Poaceae (grass family)
Germination
Seedling
Tillering
node
third leaf
first leaf
first tiller
adventitious root
second leaf
first leaf
coleoptile
seminal root
coleoptile
primary seminal root
radicle

Lodging

- Is the collapse of the canopy caused by wet & windy weather conditions and too much nitrogen use or weak varieties.
- The stem can no longer support the head and it falls over.
- Causes a reduction in yield.

Fertilisers

- Soil testing is required to find the nutrients needed in the soil.
- Generally speaking 20 –25 kg of P and 40 – 45 kg of K are required for average soils.
- P & K applied at sowing usually with a combine drill.
- N applied in spring & summer
- The level of nitrogen needed depends on the type of soil and on the previous crop.
- Too much nitrogen will cause lodging and will raise the levels of protein in the barley, thus making it unsuitable for malting.


The HIBRIX™ System for Sustainable Agriculture
Higher Yield
Protection from Frost & Early Heat
Lower Pesticide Costs
No Machinery Changes Required
Reduced Salinity
Improved Humus & Root Mass
Nitrogen for Free
Hibrix System

Weed Control

- Weeds found growing are eradicated by the use of **selective herbicides**. However a mixture normally has to be used as there can be a mixture of weeds.
- Correct application rate and time are also extremely important. Stubble cleaning and rotation can also help.
- After a root crop, weeds are not usually a problem. If growing barley after another cereal then harrowing, rotavating or shallow ploughing is necessary (crop rotation is recommended to prevent problems).
- Systemic weed killers can be used to remove Scutch and other weeds. It should be applied when the cereal is nearly ripe.
- This not only removes the weed but also speeds up the ripening process of the cereal.
- Selective herbicides are applied at autumn or spring to protect against Broad Leaf Weeds.
- During the growing season weeds and diseases must be controlled.
- A crop must be kept clear of fumitory chickweed and wild oats.
- Herbicides are used for this until a crop has established itself.
- Barley is subject to a wide variety of pests, diseases and disorders.

Diseases

The main diseases of barley in Ireland are powdery mildew, Leaf stripe, Loose smut, Take all and Eyespot.

- **Powdery Mildew:**
  - Fungal Disease
  - Diagnosed by greyish – white sp
    but it spreads all over the plants.
  - Best suited to warm and dry weather conditions.
  - The fungus can “over winter” on winter sown crops.
  - Prevented by proper stubble treatment (harrowing etc), early ploughing and fungicides.

Diseases

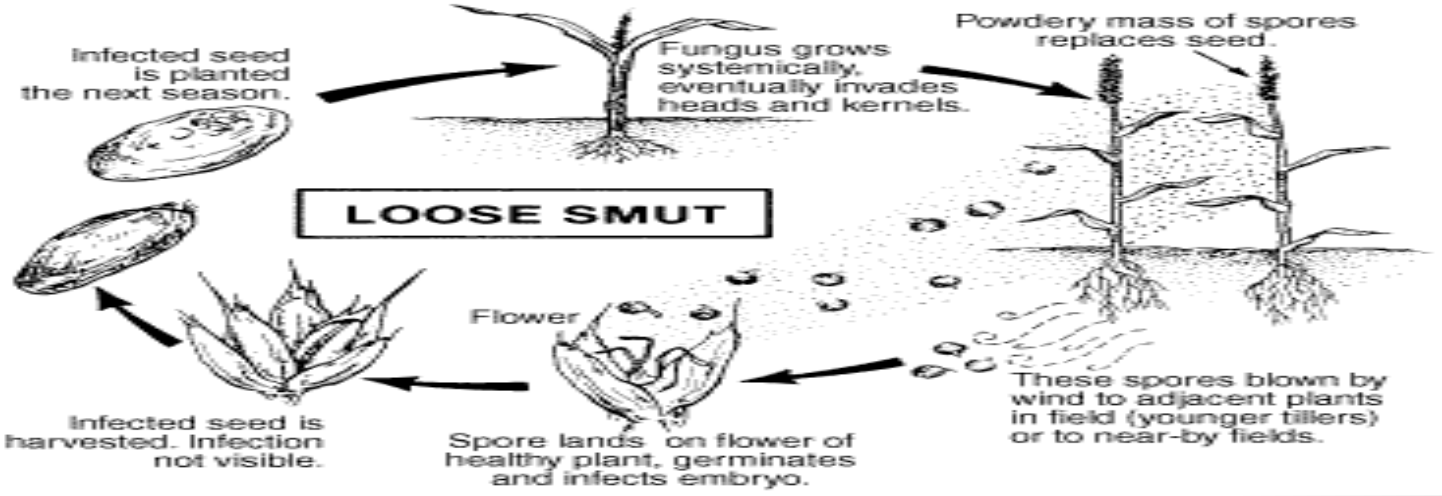
Leaf Stripe:

- Fungal Disease
- The spores of the fungus attacking the seed grain.
- When the seed germinates the fungus attacks the young plant, causing brown stripes to appear on the young leaves.
- Seed dressing of fungicides can be effective against the fungus.

Diseases

Loose Smut:

- Fungal Disease
- Brown – black dust appears on affected plants ears.
- Air borne spores are contained in this dust.
- The fungus can grow into the grain and affect the plant quite seriously.
- Prevented by seed dressing.



Diseases

Take all:

- Soil borne disease.
- Diagnosed by bleached affect on the ear of the plant.
- The ear of the plant dies before maturing and the plant produces a small grain.
- No effective seed dressing.
- If the disease is recognised then wheat and barley should not be grown on that field for a few years.

Diseases

Eyespot

- Soil borne disease.
- Diagnosed by an “eye spot” appearing on the stem just above ground level.
- It weakens the straw and causes lodging and reduced yields.
- Prevented by good crop rotation.

Pest Control

Pests:

- There are three main pests of barley, the wireworm, the leather jacket and the Gout fly. Aphids although they don't harm the Barley itself transmit the disease *Sitobion avenae* which discolours the leaves.

- **Wireworms:**
  - Are the larvae of the click beetle.
  - Only cause problems if sowing barley after a ley and even then in the first two years only as these larvae eat the roots.
  - Can be controlled using a dual-purpose seed dressing.

Leather Jackets:

- Are the larvae of several species of Crane fly or “Daddy long Legs”.
- Adult crane fly lays eggs on grass and the larvae of the crane fly feeds on grasses
- Must be controlled by spraying with insecticides or bait.

The Gout fly (Larvae):

- Attack late sown crops only.
- Feeds on the stem and the ear.
- Really only prevented by early sowing.

Non Chemical Control

- **Weed control:**
  - Crop rotation- mulches- autumn ploughing- stubble cleaning- earthing up- growth encouragement

- **Pest control:**
  - crop rotation- harvesting without delay- scarecrows- bangers- stubble cleaning, liming- autumn cleaning

Harvesting

- There are many changes observed in barley which indicate that it is ripe;
    - When barley is fully ripe, the straw becomes dry & bleached in colour.
    - The ears and grain become dry & hard. The ears bend over and lay parallel to the stem and the flag leaf withers.
- The Combine harvester cuts, threshes & delivers clean grain to bin and then it can be transferred by chute to tractor trailers for transport.

Harvesting

- Combine harvester needs to be in perfect working order so to avoid any waste or damage to the grain. It is imperative to try and avoid damage at harvesting.
- The moisture content must be between 14 & 16%. Feeding barley can be harvested a higher moisture content if adequate drying is available.
- Seed and malting barley should not be heat dried.
- These seeds should be stored in a well-ventilated place.

Combine Harvester

Yield

- Yield = Barley 5-8 Tons/ha
- Oats =4-5 tons/ha
- Wheat =8-9 tons/ha
- An average crop of Barley should yield 5 tonnes per Ha. But it is realistic to aim for 7-8 tonnes with 3 tonnes of straw.
- Straw can be fed to dry suckler cows or sold as bedding.

Storage

- Main source of damage in stored barley is germination/sprouting and fungal & insect & pest attack

- This is encouraged by high grain moisture.

- Acid treatment: Wet seed is sprayed at a rate of 5 l per ton with a strong acid (e.g. Sulphuric Acid or Proprionic Acid). This kills the embryo preventing germination & protects the grain against bacterial, fungal, insect & pest attack

Storage

- About 14% moisture is acceptable for long term storage.
- Grain drying - If grain is too dry it causes irritation to animals being fed- it is also expensive.

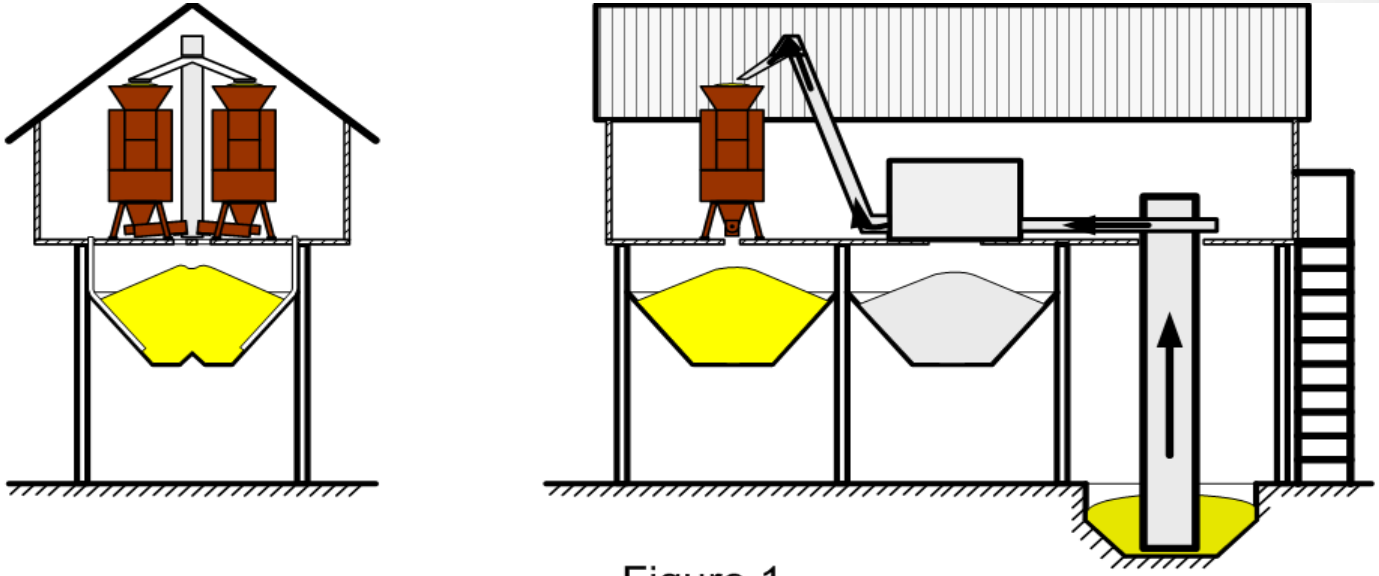


Figure 1

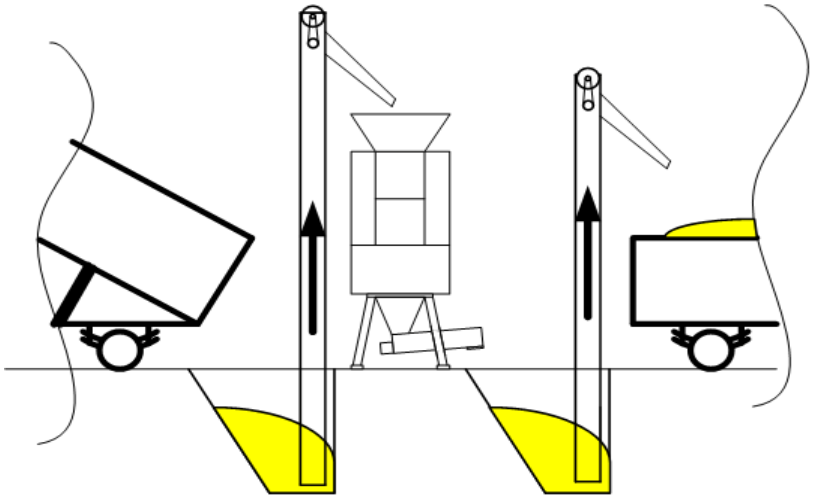


Figure 2 (On the threshing-floor, side view)

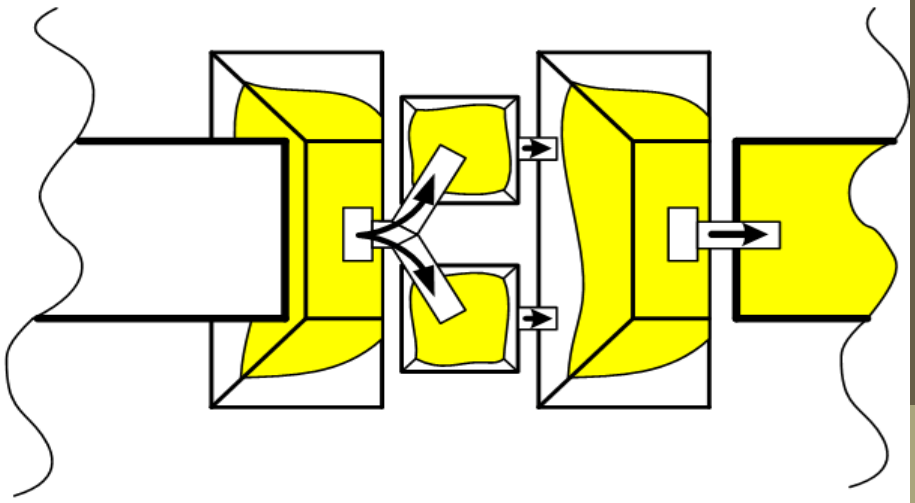


Figure 3 (On the threshing-floor, top view)

Experiments

- % Germination
- % Purity
- The determination of the digestibility of rolled grain as compared to whole grain