Maize for profit
Growing and feeding maize silage with KWS

For a more hands-on experience of our maize and the rest of the KWS UK portfolio, why not visit our Product Development Field at Thriplow, where you can see our crops in rotational situations.

For further information on varieties in our wide portfolio or demonstration events please visit www.kws-uk.com

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For a demonstration event please visit

www.kws-uk.com
Introduction

With a strong focus and a growing variety portfolio of market leading oilseed rape, maize, sugar beet, potatoes and cereal products, KWS UK is one of the UK’s leading plant breeding businesses.

Part of the KWS group, KWS UK benefits from the combined resources and expertise of a company with a 150 year pedigree.

As a result of our strong focus on most major UK crops we are able to position our products across the rotation for maximum margin and market potential for farmers.

KWS offers a wide portfolio of leading varieties covering:

**Oilseed Rape**
- Winter and spring Hybrid, Open pollinating and High erucic oilseed rape

**Maize**
- Forage, Grain and Energy

**Sugar Beet**
- Standard varieties, Rhizomania resistant and Nematode resistant

**Potatoes**
- French fries, crisper, salad and table varieties

**Cereals**
- Winter wheat, Spring wheat, Winter barley, Spring barley, Winter oats and Spring oats

Maize for Profit is your KWS guide to growing and feeding maize silage. In this booklet you will find useful and practical information on:

- Choosing varieties
- Site selection and drilling
- Harvesting for silage, corn cob mix and grain maize
- Feeding maize silage
- Cross compliance issues

For further information on our portfolio, please visit www.kws-uk.com
KWS continues to invest in research and development, greater trialling of new hybrids and seed production facilities. Assisted breeding and selection technology brings new products to market over a shorter time period.

Site selection

With continuing progress in yield, maturity and quality, the UK maize area continues to advance northwards into more marginal and less favourable areas. Comprehensive evaluation of new early hybrids under such conditions allows us to recommend our products with greater accuracy. Even the earliest varieties cannot perform to their full potential if the site and field conditions are not suitable.

Growing maize primarily for its bulk yield and energy is easily achieved on more favourable areas with the use of later maturing varieties. With advances in breeding, this high yield potential is gradually being transferred to earlier maturing hybrids more suited to intermediate sites.

In colder areas with heavy soils, growing maize for maximum starch is often the most cost effective solution. Variety choice should be based on very early and ultra-early hybrids, where necessary.

Selecting varieties by overall maturity is the basis for successfully growing maize that will mature safely, both in favourable and in more difficult years. A key factor in this process is testing maize for its overall stability taking into account the variation between growing seasons.

If a maize hybrid shows poor stability, it is unlikely to give consistent yields or quality between seasons. Varieties available in the UK have been classified into different maturity groups, which are recommended for different site and field conditions.

Maturity requirements

<table>
<thead>
<tr>
<th>Maturity group</th>
<th>Soil type</th>
<th>Altitude</th>
<th>Heat units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultra early (FAO 150-160)</td>
<td>*****</td>
<td>****</td>
<td>***</td>
</tr>
<tr>
<td>Early (FAO 170-180)</td>
<td>*****</td>
<td>****</td>
<td>***</td>
</tr>
<tr>
<td>Maincrop (FAO 190-210)</td>
<td>***</td>
<td>***</td>
<td>******</td>
</tr>
<tr>
<td>Late (FAO 230-250)</td>
<td>**</td>
<td>**</td>
<td>******</td>
</tr>
</tbody>
</table>

Data source: KWS UK 2011

Soil type: ***** Heavy, cooler soils - Light, warmer soils
Altitude: ***** High altitude, north facing - Lower altitude, south facing
Heat units: ***** Later maturity - Earlier maturity

Soil type

Maize generally prefers lighter soils but can be successfully grown in heavier loam and clay soils. This approach will often necessitate delayed drilling. Earlier harvesting will be more important on heavier soils to prevent compaction and runoff.

Lighter soils will warm quickly in the spring and this will tend to promote earlier drilling using later varieties. Growing maize on north facing sites should be avoided if possible.

Altitude and heat units

Altitude has a major effect on the radiation available for the crop to reach maturity. Maize can now be grown as high as 1000 ft above sea level in the open using the very earliest hybrids available. However the majority of the crop is grown at significantly lower height, where conditions are warmer.

Variety selection should be based on the estimated level of heat units and general soil and field conditions. Typically varieties in maturity groups 11 or 12 (ultra early) require up to 20% fewer heat units than those in groups 5 or 6 (medium early).
Variety selection

Selecting maize varieties based on your feeding requirements will help to ensure a high potential for increasing productivity on farm.

KWS UK are able to recommend particular varieties to suit your region and field conditions. We can also give an accurate guide to the nutritional quality of all our hybrids, particularly starch and cell wall digestibility.

The ability to match quality characteristics with feed requirements is a key consideration in selecting new hybrids as they emerge from our breeding programme.

The main considerations for variety selection can be summarised based on the site or soil type and feeding requirements:

Site / soil requirements

• Early vigour and cold tolerance
• Earliness of maturity
• Yield performance
• Overall stability
• Disease resistance

Feed requirements

• Starch content / yield
• Metabolisable energy
• Digestibility and feed value
• maize inclusion in the ration

Key considerations for variety choice

<table>
<thead>
<tr>
<th>Low to moderate Maize inclusion (25-50%)</th>
<th>Moderate to high Maize inclusion (over 55%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High starch content (33-35%)</td>
<td>Moderate to low starch content (29-32%)</td>
</tr>
<tr>
<td>Earlier maturity (NIAB Groups 8-9+)</td>
<td>Later maturity (NIAB Groups 6-7)</td>
</tr>
<tr>
<td>Total starch yield</td>
<td>Total digestible yield</td>
</tr>
</tbody>
</table>

Data source: KWS UK 2009

Drilling

Getting the most from maize largely depends on drilling at the right time and in good conditions. When to start drilling will depend on soil conditions, temperature and seedbed moisture. Modern hybrids have a high degree of cold tolerance but should not be drilled before soils have reached an even temperature for 3-4 days (8°C for light soils, 10°C for heavy soils) to give the best possible establishment.

Symptoms show quickly where maize is drilled before soils are warm enough. Plants are typically slow to emerge with deep purple staining on the stem and leaves. Under these conditions the crop will only respond once temperatures warm again. Placement fertilisers or micro granules can aid establishment in these conditions.

Where conditions are very dry it is advisable to reduce seed rates. Drilling deeper (4-5 cm) into adequate moisture will help ensure seeds germinate evenly. This is also best practice when drilling on heavier soils. In recent years the area of maize grown using plastic film has increased allowing later varieties to be grown by providing a lengthened growing season. The greatest benefit comes from late maturing varieties where yields can be maximised and harvest can be brought forward by up to one month.

Considerations before drilling

• Soil temperature
• Seed bed and soil structure
• Moisture availability
• Short term weather forecast

Effects of premature drilling

• Slowed germination
• Uneven emergence
• Reduced nutrient uptake

Effects of late drilling

• Delayed harvesting
• Requirement for earlier maturing varieties
• Increased risk of lodging

Considerations for using placement fertilisers

• Soil type (heavy, medium or light soils)
• Drilling date (early, late)
• Site and yield potential (e.g. warm site with light soils, cold site with heavy soils)
Row spacing

Work conducted over several years has established a yield advantage from close row sowing. Typically the row spacing is reduced from the standard width of 76 cm (30”) to 37.5 cm (15”). Closer row spacing produces a denser crop with higher fresh weight yields and is best adopted on favourable sites.

Thicker crops also show a faster dry down over standard row widths but care should be taken to avoid excess plant numbers as this is likely to induce lodging.

Close row width spacing

Advantages
- Faster row closing and inhibition of weeds
- Reduced erosion risk
- Minimal risk of excess residual nitrogen

Disadvantages
- Higher risk of seed bunching if using a non precision drill
- Potential for higher lodging on exposed sites
- Overall higher drilling cost
- Precludes crimping or grain maize harvesting

Seed rate settings should match the selected row spacing. For standard row widths aim for between 10-12 cm between each seed. Check this once drilling starts to ensure the correct number of plants. Where close row widths are being used aim for a wider spacing between 20-22 cm and offset between each row, giving each plant adequate space.

The growing crop – management considerations

1. Total dry matter
2. Stover dry matter
3. Cob dry matter

Emergence
Seedbed conditions/soil type
Starter/Micro fertilisers
Drilling (temperature, seed rate, row spacing)
Pre-emergence herbicides

Post emergence herbicide application
Trace element deficiency (leaf purpling/yellowing)

Vegetative Growth
General crop condition
Optional eyespot fungicide application (by eight leaf stage)

Tasseling
Peak moisture/nutrient demand (influence of soil type and fertiliser application)

Silage Maturity
Silage harvesting (28-35% dry matter)
Post harvest cultivations
Cross compliance and soil management

Grain Maturity
Harvest method (CCM, crimped/dried grain)
Post harvest cultivation/soil conditions
Harvesting

Later maturing types can be considered where an early harvest date is not critical.

Cutting prematurely will severely impact potential dry matter intake, particularly the availability of starch and energy. Poor feed intake, palatability and high acidity all result from maize ensiled before it reaches maturity. However, leaf diseases such as Eyespot (Kabatiella zeae) will cause the crop to die back rapidly. In this scenario aiming to harvest early may be the only solution to help retain crop value.

If the crop becomes too dry, feed intake and digestibility can be impaired. Harvesting too late will risk frost damage to the grains, causing moulds and spoilage once ensiled. As a rule of thumb ensure adequate cob maturity with grains at the hard dough/hard ripe stage as harvest begins to prevent the crop becoming too dry if harvest is interrupted.

Effects of harvesting too early
- Lower yield
- Reduced energy, starch and ME which results in lower intake potential
- Higher risk of clamp effluent which will require a longer chop length
- Poor dry matter intake and palatability resulting in acidic silage

Effects of late harvesting
- Higher harvesting costs and increased field losses
- Low digestibility and palatability
- Excessive dry matter and poor clamp stability
- Difficult clamp consolidation which will require a shorter chop length
- Soil damage/compaction

Grain maturity

<table>
<thead>
<tr>
<th>Grain maturity</th>
<th>Description</th>
<th>Cob DM (%)</th>
<th>Whole plant DM (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>Grain immature</td>
<td>Avoid premature harvesting</td>
<td>10-15</td>
</tr>
<tr>
<td>Soft dough</td>
<td>Grains become firmer, husks remain green</td>
<td>20-28</td>
<td>20-27</td>
</tr>
<tr>
<td>Hard dough</td>
<td>Silage maturity reached at 'hard dough' stage, Reduced risk of clamp effluent</td>
<td>30-45</td>
<td>28-32</td>
</tr>
<tr>
<td>Hard ripe</td>
<td>Grain at 'hard ripe' stage, Crop ready for late cut silage or CCM</td>
<td>48-50</td>
<td>33-35</td>
</tr>
<tr>
<td>Fully ripe</td>
<td>Grain fully matured, Husks died back Ready for crimped maize or late cut CCM</td>
<td>65-70</td>
<td>36-45</td>
</tr>
</tbody>
</table>

Data source: KWS UK 2009

Grain maturity indicator

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Ideal harvesting conditions for maize
Immature maize

Under difficult conditions, getting the crop to 30% dry matter or higher is not always possible. Harvest management for immature maize should be based on recovering as much feed value as possible.

• Delaying harvest to give the crop a longer window to mature will help boost the total ME and starch content
• Where the crop is very wet increasing the chop length (20-25 mm) will encourage less effluent
• Increasing the cutting height will promote a higher starch content at the expense of total DM yield

Over ripe maize

One of the biggest areas for concern is maize crops that dry down too quickly. This is most commonly caused by growing a variety that may be too early for the site. If the crops become too dry, aim for a very short chop length and correct set up of the corn cracker unit to damage all grains.

• Reducing the chop length in drier crops will make the silage easier to compact in the clamp
• Avoid chopping excessively short (recommended minimum 6-15 mm)
• Silage that becomes too dry will also begin to heat rapidly. Applying an additive to help prevent moulds and heating should reduce the risk of further losses

Ensiling and clamp management

Ensiling and clamp management are key to preserving the full value of maize slage. It is also the area where the biggest losses and waste can occur. Managing the clamp to reduce losses should involve pre, during and post harvest measures.

Checklist

Pre harvest
• Ensure a narrow clamp design to limit the surface area exposed to air
• Clean the clamp of old slage prior to harvesting the new crop
• Clear an adequate working area for machinery

Harvest
• Consider the use of silage additives, particularly for crops harvested relatively late
• Adjust the chop length and corn cracker to match crop maturity
• Sheet and seal the walls and top of the clamp after rolling

Feedout
• Ensure a rapid feedout to prevent spoilage. Aim for 1m/day in winter, and 2m/day in summer
• Keeping a tight cut will prevent moulding of the clamp face
• Clear away any spilt slage to prevent heating

Manage chop length for ration structure

Chop length

Chop length primarily depends on how much maize is being fed and the desired ration structure. With a wide variation in feeding regimes maize silage typically forms between 25% for mainly grass based diets and over 70% across more intensive systems.

Effectively managing chop length and chop quality will help promote a consistent feedout and higher voluntary intakes.

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Crimped maize

With the growing demand for crimped maize, KWS has introduced several dual purpose varieties offering greater harvest flexibility. Candidate varieties are trialled extensively to ensure they are suitable. Standing power, grain yield and threshability being the key criteria.

Crimped maize provides extra energy to the ration in a form that by-passes the rumen. Typically this can exceed 14.5 ME and over 70% starch. The majority of grain...
Silage analysis

<table>
<thead>
<tr>
<th>Silage analysis</th>
<th>Average value</th>
<th>Harvest window</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Early (Mid Sep)</td>
<td>Mid (Late Sep)</td>
</tr>
<tr>
<td>Dry matter (%)</td>
<td>31</td>
<td>**</td>
</tr>
<tr>
<td>Digestible value (%)</td>
<td>60</td>
<td>****</td>
</tr>
<tr>
<td>ME (MJ/Kg)</td>
<td>11.2</td>
<td>**</td>
</tr>
<tr>
<td>Starch (%)</td>
<td>30</td>
<td>**</td>
</tr>
<tr>
<td>NDF (% of DM)</td>
<td>50</td>
<td>****</td>
</tr>
<tr>
<td>pH</td>
<td>4.2</td>
<td>**</td>
</tr>
</tbody>
</table>

Data source: KWS UK/Dairy Group 2008
Values: ** Low *** Average **** High

**Dry matter**

As the crop matures, sugars are converted to cob starch. At the same time the remaining plant stover starts to die back, contributing to higher dry matter and a build up of indigestible fibre, particularly in the lower stem.

**Digestible value/fibre**

Cell wall digestibility and digestible fibre levels begin to decrease with a build-up of lignin, particularly in a late harvest scenario. Cutting height can influence the silage digestibility. Raising the cutter bar will prevent intake of the lower stem and boost starch contents.

**ME**

In general delayed harvesting will result in a higher overall ME provided the crop is not allowed to become over-ripe. The ME figure tends to remain static as energy is converted from stover digestibility into cob starch.

**Starch**

Harvest date impacts on the level of starch. Cutting earlier can be used to limit the starch content, specifically where a high level of maize is fed. Where higher starch is required, delaying harvest or raising the cutting height will increase starch levels.

**pH**

Clamp stability is a key factor of fermentation quality. This involves controlling the pH to make sure the silage does not become too acidic. Silage additives can be used to control acidity if the crop is not harvested at an optimal dry matter.

**Feeding**

Maize is a proven forage across many UK herds, either to complement grass, wholecrop silage or fed exclusively. Managing the crop for best feed efficiency is key to achieving the high intake potential it offers.

**Key advantages of maize**

- Slowly degradable starch (30-35%)
- High energy concentration (11.0-11.5 ME)
- Beneficial effect on rumen stability (pH 6.2-6.5)

**Harvest at the correct time**

Aim to start harvest as the crop becomes mature. The best intakes from maize silage are between 30-35% dry matter.

**Analyse silage**

A silage analysis is advisable to estimate the quality and range of nutrients for diet formulation and inclusion rates. It also indicates if the silage is either too wet or too dry, allowing the ration to be adjusted accordingly.

**Intake potential from maize silage**

<table>
<thead>
<tr>
<th>Relative content</th>
<th>Dry matter (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>28</td>
</tr>
<tr>
<td>Fibre (%)</td>
<td>24</td>
</tr>
<tr>
<td>Starch (%)</td>
<td>25</td>
</tr>
<tr>
<td>ME (MJ/Kg)</td>
<td>10.9</td>
</tr>
<tr>
<td>Feed intake (Rel %)</td>
<td>85</td>
</tr>
<tr>
<td>Clamp losses (%)</td>
<td>20</td>
</tr>
</tbody>
</table>

Data source: KWS UK/Dairy Group 2008

Manage maize for best feed efficiency.

**When to feed**

If offered early in the lactation, maize will support an increased level of production. Introduce gradually, allowing time for cows to adjust to higher feeding rates for maximum performance.

**Maize in the ration**

<table>
<thead>
<tr>
<th>Ration (freshweight Kg)</th>
<th>Maize inclusion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>40</td>
</tr>
<tr>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>60</td>
<td>70</td>
</tr>
</tbody>
</table>

Data source: KWS UK/Dairy Group 2008

Assumptions:
1. Maize silage (30% DM, 11.2 ME, 30% Starch)
2. Grass silage (30% DM, 11.2 ME)
3. Feed intake and inclusion given as fresh weight (Kg)
Cross compliance

As part of the cross compliance framework farmers must implement certain practices with regard to maize. Further advice should be sought from your local agronomist or advisor.

The majority of these regulations relate to good crop management. The key areas of compliance for forage maize are outlined as follows:

**Nitrogen regulations**

- Field and crop limits apply across the whole farm
- Nitrogen applications are limited by crop type, referred to as the NMax limit
- Applications must take into account total available nitrogen

When calculating application rates ensure nutrient supply from organic manures and any applications via starter, placement or other inorganic fertilisers are taken into account.

**Nutrient planning**

A nutrient plan should be produced to identify where nitrogen applications are required, considering the field conditions and existing soil management plans.

**Stubble or bare soil**

The use of slurries and other organic manures to stubble on bare soil requires rapid incorporation, preferably within 24 hours following the application.

Where maize is harvested late and in wet conditions, it is not always possible to cultivate after harvest. Where this occurs routinely, areas of waterlogged and compacted soil are likely to occur. Bringing forward the harvest date is usually possible with an earlier maturing hybrid.

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Sugarbeet Corn Wheat Potato Rapeseed Rye/Triticale
Oats Pea Barley Sunflower Catch Crops
Sorghum Soja Fodder Beet