Maize Best Practice

Ensiling, Feeding & Nutrition – AD and Animal Performance

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KWS

About KWS

KWS is one of Europes' leading maize breeders, specialising in the production of hybrids to suit all growing situations for both livestock and AD.

Our UK focus is to select maize hybrids capable of consistently achieving top on-farm performance.

As part of the KWS Group, we benefit from the combined resources and expertise of an organisation with a 160-year pedigree and which invests 15% of its annual turnover in research and development.

From the team at KWS UK

Introduction

This guide is intended to help farmers and advisers to get the most out of their maize crop.

We are happy to provide expert advice on varietal choice for specific farm situations; please do not hesitate to get in touch if you require any assistance!

Contents

Maize production costs

Maize offers considerable advantages when grown alongside other forage crops.

- As a high starch forage crop with a growing UK acreage, more and more farmers recognise its benefits
- The 2020 UK maize area is now in excess of 200,000 ha, double the acreage compared with 1995
- The cost of production/ha is directly linked to crop yield. Farmers with suitably light to medium soils, in moderate to high heat unit areas, often achieve consistently low costs per tonne, especially compared to bought-in concentrate feed

Maize Production Costs – UK Average

Variable Costs	Per Ha
Seed	£ 180.00
Fertiliser	£ 113.00
Herbicide	£ 54.00
Additive	£ 8.00
Operational Costs	**Per Ha**
Land Preparation	£ 339.00
Drilling	£ 48.00
Fertilising & Spraying	£ 24.00
Harvest & Clamping	£ 180.00
Total	**£ 946.00**

Source: John Nix Pocketbook 2020

Practical advantages from maize

Dairy

- Maize production offers the opportunity to utilise slurry, saving storage space & input cost of inorganic fertilisers
- Particularly useful on intensive dairy units within NVZ areas

Beef

- Maize silage is a 'rocket fuel' for ruminant livestock, supplying high levels of home-grown starch for rapid live-weight gain and carcass quality
- Spreads forage production risk in drought-prone areas compared to grass – only systems

AD

- Maize silage is an excellent feedstock for AD plants and makes up a significant percentage of the total feedstock on many plants
- Contract maize production can help growers to increase income as an alternate crop in the rotation

Key Benefits of Maize Silage for Livestock

- Excellent source of slowly-degradable starch (30 - 36%)
- High energy concentration 11.0 -12.0 ME
- Beneficial effect on rumen stability (pH 6.2 - 6.5)
- Reduces bought-in feed costs and allows producers to increase stocking rates, or free-up valuable acreage for other crops

Maize silage is a highly palatable crop which can promote livestock intakes, particularly at a DM (dry matter) range of 30-35%. For early lactation dairy cows, it will support increased production levels.

Maize inclusion compared to grass only systems

Silage Inclusion	Grass (100%)	Grass (66%) + Maize (33%)	Grass (25%) + Maize (75%)
Forage DM Intake (kg/day)	9.8	11.2	13.0
Milk Yield (kg/day)	22.0	25.2	27.5
Milk Fat (%)	4.2	4.0	3.9
Milk Protein (%)	3.0	3.1	3.2

Source: CEDAR (University of Reading)

Introduced gradually, maize silage will prepare cows for higher feeding rates to produce maximum performance and it can be safely added to a TMR (total mixed ration) at a significant inclusion rate.

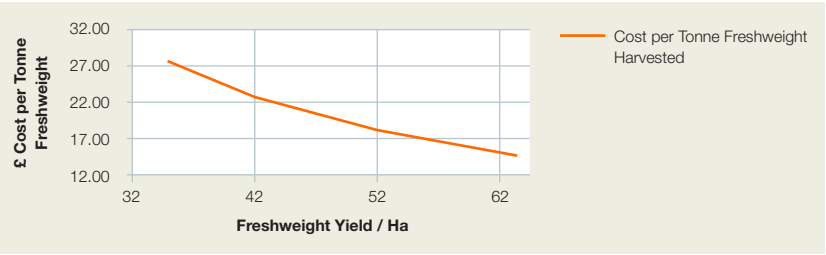
Its energy concentration is approx. 50% more efficient for gaining body condition, compared with an autumn grass grazing situation.

Production consistency

Breeding efforts to develop modern hybrids clearly deliver far great production consistency, even in the last 5 – 10 years:

- Modern KWS maize hybrids offer superb yield stability, with the capability of producing consistently high silage performance; even in a challenging growing year
- This consistency factor means production cost per KG/DM is also relatively predictable, compared with many other forages
- Out-yielding the majority of its forage rivals, including grass and wholecrop silage, maize silage will boost home-grown DM production/ha

Cost per Tonne Freshweight Harvested



Source: John Nix Pocketbook 2020

In addition, a maize silage fermentation will remain stable for several years, as long as it is correctly stored.

Consistency of feedstock, whether maize is grown for livestock or AD, is an increasingly important factor, for ensuring forage production and on farm income.

Chop length

The effective management of chop length will help to promote a consistent feed-out and encourage livestock intakes, but decisions on settings will depend on end use and harvest conditions.

Maize silage for livestock requires a longer chop length compared with maize intended for biogas production.

- High DM% (> 40%) crops – reduce chop length to encourage compaction and consider an additive
- Low DM % (< 30%) crops – increase chop length in a wet harvest, to minimise effluent levels
- AD / Biogas – recommended chop length 7-9mm, up to a maximum of 12mm
- Dairy / Beef – recommended chop length 15-25mm

AD / Biogas – Chop Length and Fermentation

A low surface area is needed in order to achieve a rapid fermentation.

- If chop length is too long, it will provide only a limited surface area for the bacteria to break down the material.
- However there is a physical limit to the minimum figure for producing a silage with the optimum texture for clamp stability, effluent reduction and ease of handling and feed-out.

TOPTIP

Choose a figure at the higher end of the scale, if feeding maize silage to cattle at significant TMR inclusion rates. This will increase valuable 'scratch factor' and help to reduce the potential acid-load (PAL), especially if the standing crop DM falls below 30%.

Ensiling and clamp management

Correct ensiling and clamp management are the keys to preserving the full value of maize silage

Pre-harvest

- A narrow clamp design will limit surface area exposure
- Clamps should be cleaned before re-use
- An adequate working space is required for machinery

Harvest

- Late-harvested crops may benefit from an additive
- Match chop length and corn cracker settings to crop maturity (to maintain surface area for clamp stability)
- Sheet and seal walls and top of clamp after rolling

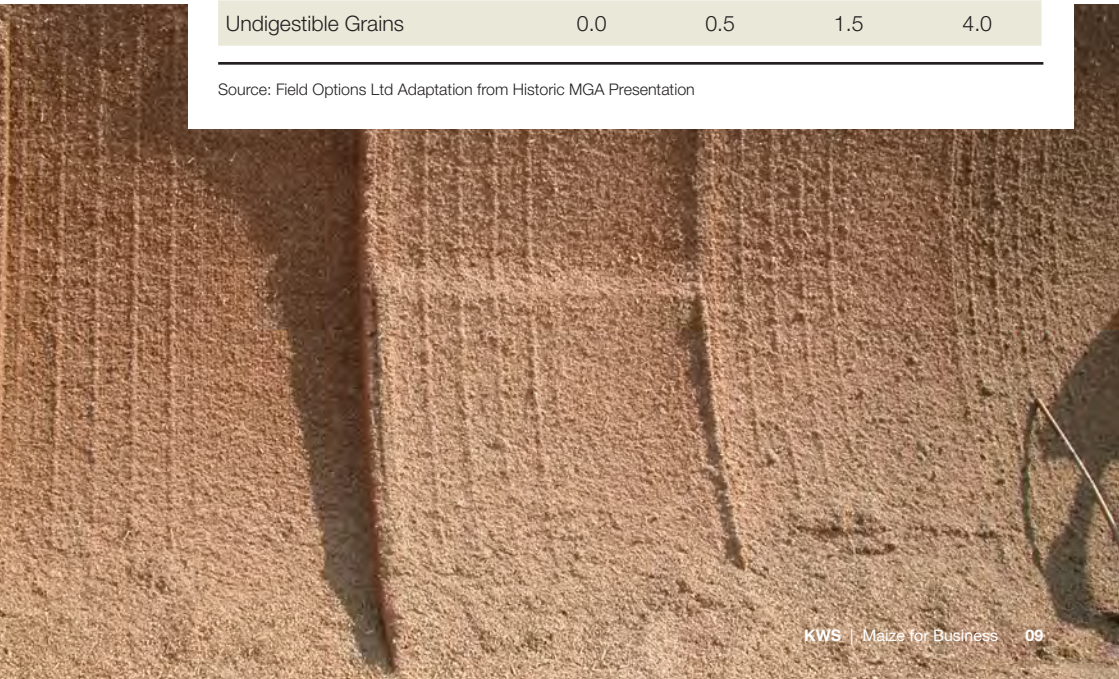
Feedout

- Ensure a rapid feedout to prevent spoilage, aiming for 1m/day in winter and 2m/day in summer
- It is important to keep a tight cut, to prevent moulding at the clamp face
- Any spilled silage should be removed, to reduce the risk of heating

Influence of DM % on DM Losses in Maize Silage

	Dry Matter %			
	28%	30%	35%	40%
Effluent	4.0	1.0	0.0	0.0
Fermentation	12.0	10.5	9.0	7.3
Silo, Surface & Face	5.0	7.0	8.5	10.0
Trough	1.0	1.0	2.0	2.5
Undigestible Grains	0.0	0.5	1.5	4.0

Source: Field Options Ltd Adaptation from Historic MGA Presentation



Maize for AD / biogas

Maize for AD – Key Benefits

- Low growing costs/tonne
- High yield potential on lighter land
- Offers the opportunity for blackgrass control + wide herbicide spectrum
- Can be grown continuously, provided replacement N, P & K are returned for subsequent cropping

Optimising Gas Yield

Contract grown maize silage typically relies on a fixed contract price / tonne, which often results in yield performance becoming the major production criteria.

However AD plant owners are increasingly moving to optimise gas yield / tonne, designed to boost methane yield by targeting higher feedstock quality.

KWS recommends the following criteria for raising gas yields in maize:

- Utilise a split of FAO maturities to spread harvest window
- Consider early (< FAO 180) – higher starch hybrids for crops grown at an extended haulage distance to the main clamp (typically greater than 6 miles)
- Ensure late (> FAO 200) hybrids, sown for maximum DM yield, are grown as close as possible to the main clamp
- Minimise the use of satellite clamps, as silage quality can often be reduced
- Target an average figure of 200 (m^3/t fresh) – the standard for biogas yield in maize

Biogas yield for common crop feedstocks

Crop Feedstock	DM (%)	Biogas Yield (m^3/t Fresh)	Methane Yield (m^3/t Fresh)
Maize Silage	31	200	110
Maize - CCM	65	419	218
Whole-crop Cereals (Hybrid Rye, Triticale, Wheat, Barley, Hybrid Barley)	30	151	80
Energy Beet	23	142	77
Cereal Grain	87	554	288
Straw	86	310	161
Grass Silage	30	170	90

Source: KWS

Maximising methane yield

Key factors affecting methane yield (m^3/t)

- Harvest date (lignin%, DM%, chop length)
- Chop length (fermentable surface area)
- Storage (fermentation, absence of air)
- Dwell time (substrate mix, AD plant design)

Maximising the methane yield of maize silage for AD will improve plant efficiency.

Aim for a target DM of 33-35%, with starch at 32-35%, and a lignin content below 4%.

Avoid crops at below 27% DM, to minimise effluent.

Starch High starch levels (33% +) are important for maximising methane production and rise in parallel with DM%.

Lignin A high lignin content is a negative attribute and increases in late-harvested crops. Avoid harvesting at a crop DM of more than 36%. Raising the cutting height is a simple method of lignin reduction in this scenario.

Corn cob mix

Corn cob mix (CCM) is harvested using a row-dependant grain maize header, coupled to a forage harvester. It comprises the ripe maize ear (grain, spindle & sheath), and is ensiled in either clamps or ag-bags.

CCM is growing in popularity as livestock producers reduce their reliance on bought-in feed and AD plants increase their focus on optimising gas yield / tonne of feedstock.

CCM – Key Benefits

- ☑ High by-pass starch content and yield potential
- ☑ ME of approximately 13.0 MJ/Kg DM
- ☑ Low effluent risk
- ☑ Storage requirement 50% lower compared with maize silage
- ☑ Over-ripe crops can be harvested for CCM as a silage alternative
- ☑ Can be stored in an ag-bag if clamp space is limited
- ☑ Low risk of soil runoff / compaction during harvest

CCM is chopped and ensiled similar to maize silage. The product contains the cob sheath, which adds 'scratch factor,' to promote rumen health.

CCM is usually cut 10-14 days later than silage, but the date can be brought forward using ultra-early hybrids (FAO 150 – 160).

CCM for Livestock and AD

Livestock

- CCM is a very high starch feed (typically 45%) and contains a much greater percentage of by-pass starch than silage. Ideal for dairy or beef units which already utilise a high maize silage inclusion (70% +) in the TMR.

AD/Biogas

- CCM gives a significant increase in biogas yield, compared with maize silage. It will lift gas production from 200 m3/tonne to 350 - 400 m3/tonne (freshweight).

Crimped maize

Crimped maize provides extra energy to the ration in a form that by-passes the rumen.

Typically this can exceed 14.5 ME (MJ/Kg) and over 70% starch.

The majority of grain maize grown in the UK is crimped, with a limited area for dried grain. The UK area has grown considerably as contractors equip to handle the crop.

Combining grain maize – only the ear enters the feederhouse. The stover is left on the field, assisting with field travel at harvest.

Candidate varieties are trialled extensively to ensure they are suitable with standing power, grain yield and threshability being the key criteria.

Key benefits

- ☑ Harvested with a conventional combine and maize picker header attachment
- ☑ High yield potential (9-12 t/ha) of fresh grain
- ☑ Low risk of effluent (65-70 DM%)
- ☑ Offers savings on bought-in concentrates
- ☑ Zero drying cost compared with dried grain maize
- ☑ Elite starch source (65-70%) and ME (MJ/Kg) typically in excess of 14.5 MJ/Kg. Also contains a much greater % of by-pass starch (25-30) compared with maize silage or whole-crop cereals.

Typical Analysis

	Maize Silage	CCM	Crimped Maize
Fresh Yield (t/ha)	40 – 45	12 - 18	9 - 12
DM (%)	30 – 35	45 – 55	65 – 70
Starch (%)	30 – 33	40 – 45	65 – 70
NDF (%)	42	45	38
ME (MJ/Kg)	11.2	13.0	14.5
pH	4.2	4.3	4.0

Source: KWS

The crimping process uses specialist crimper rollers to crush the wet grain, exposing the endosperm. The clamp should be filled rapidly and packed as tightly as possible, as the material will degrade following air exposure. Images courtesy Kelvin Cave Ltd.

Silage analysis

Harvest timing is the key factor in determining silage quality and an analysis is vital for assessing the forage profile optimising ration formulation & intake potential.

Relevant for both ruminant and AD/Biogas, analysis's aids optimizing the harvest time every season.

Effects of harvesting too early (< 30% DM)

- Dilute ME content (MJ/Kg) and starch (%)
- Increased ADF (%) [acid detergent fibre] owing to more acidic silage
- High sugar content (%)

Effects of late harvesting (> 40% DM)

- Very high ME content (MJ/Kg) and Starch (%)
- Increased NDF (%) [neutral detergent fibre] owing to more alkaline silage
- Very low sugar content (%)

Procedures for silage analysis sampling

- Modern silage analysis uses an NIRS (near infra-red spectroscopy) and generates results within seconds, either via mobile or on board scanning
- Where this is not available, individual samples must be taken from fresh, or clamped (ensiled) maize
- Ensure this sample is labelled and then frozen in storage, prior to being sent for lab analysis

Onboard DM% scanning is become increasingly common (Image courtesy John Deere)

Typical Maize Silage Analysis at Different Dry Matter Levels

Relative Content	Dry matter (%)			
	28	30	33	36
Fibre (%)	24	20	18	16
Starch (%)	25	30	32	36
ME (MJ/Kg)	10.9	11.2	11.4	11.6
Feed Intake (Rel %)	85	98	100	92

Source: KWS

Raising the cutting height will prevent intake of the lower stem, whilst simultaneously raising both DM% and starch%

- Cell wall digestibility will decline following a build-up of lignin, which is common in a late harvest situation.
- Ash is essentially contamination; usually through soil. Cutting plants too close to the ground is the most common cause of the problem.

Fresh v Ensiled Crop

- Maize silage should be left to settle for at least six weeks before analysis.
- As winter progresses it is advisable to take a second sample, as starch degradability will improve. Rations can then be adjusted accordingly.
- It is recommended to compare an analyses when switching from old crop to new season maize

myKWS
Digital consulting for farmers

The free myKWS service supports you with digital tools that help you with relevant decisions around your cultivation, as well as an E-Mail-Service which informs you about relevant topics at the right time.

Maize Heat Units Tool

Our free, online heat units tool allows growers and advisers to check predicted harvest dates, based on the FAO (maturity rating) of the selected hybrids. Using the farm postcode and sowing date, it will produce a calculation for individual farms based on the previous 5-year temperature average.

- Your predicted harvest date is shown based on the crop reaching a grain kernel moisture content of 35 %
- Actual silage harvest is around 3-4 weeks before this depending on ripening conditions
- Enter your full UK postcode
- Enter your sowing date

Soil Temperature Tool

The free temperature service helps with decisions on drilling date. Growers enter their postcode, to find the real-time soil temperature at 10cms at the five closest weather stations to the farm. The service also provides soil surface temperatures, to highlight frost risk.

- Enter your full UK postcode (space needed).
- Data is updated daily.
- Optimum drill timing depends on soil conditions, temperature and seedbed moisture

Find tools on our website: **www.kws-uk.com** and how to sign-up to receive our quarterly newsletter

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