Forage Crops

Arable Silage

- **Harvesting** – The crop usually requires a growing period of 12-15 weeks to mature. Ideally the cereal grain should be at the milky to early dough stage of maturity. The bottom pea pods are formed but not completely swollen and are 3-4cm long. The first flowers are beginning to drop off and other flowers are coming into bloom. An additive may help reduce feeding losses.

- **Feeding Value -** The digestibility of arable silage can be disappointing (60-65% DMD), indicating it would not be a suitable energy source for high producing animals unless supplemented with sufficient energy-rich concentrate. Arable silage is most suited to dry cows and store cattle. Protein content is often quite high, reflecting the impact of the legume. Preservation tends to be poor because of the low DM, low sugar content and high buffering capacity (impact of the legume). Ideally a crop such as this would be harvested on a very dry day and would receive an effective wilt or a higher rate of preservative.

Table 1: Chemical composition of barley + pea crop at harvest and at feed out (silage)

	Feed out
Dry matter %	18.0
Ash (% DM)	10.7
Digestibility (%)	62.3
Neutral detergent fibre (% DM)	50.3
Sugar (% DM)	1.2
Crude protein (% DM)	18.0
Ammonia-N (% N)	16.4
pH	4.37

Source: Teagasc, Grange Beef Research Centre

Whole crop

What to Harvest as Whole Crop

Whole crop wheat or barley silages should ideally be produced from crops that would have yielded at least 8 ton harvested grain DM / hectare.

Table 2: Guide to DM Content for Whole Crop and Moist Grain Harvest

<table>
<tr><th>Whole Crop DM %</th><th colspan="2">Description</th><th>Crop Colour</th><th>Grain Texture</th><th>Grain Moisture %</th></tr>
<tr><td>36-38</td><td rowspan="4">Fermented whole crop</td><td rowspan="4"></td><td>Green ear
Green stem</td><td>Soft dough</td><td rowspan="4"></td></tr>
<tr><td>39-42</td><td>Ear starting to yellow, stem green</td><td>Soft cheddar</td></tr>
<tr><td>43-46</td><td>Ear mainly yellow, stem starting to yellow</td><td>Soft cheddar</td></tr>
<tr><td>47-54</td><td>Ear and stem mainly yellow, some green on stem</td><td>Hard cheddar, grains easily split with thumbnail. Assume crop moisture loses 1-2% per day</td><td>> 45</td></tr>
<tr><td>55-65</td><td>Urea treated whole crop</td><td rowspan="2">Crimped grain (60-70% DM)
Urea treated grain (65-72% DM)</td><td>Ear and stem yellow, hint of green on stem</td><td>Hard cheddar, moist grains can still be split with thumbnail</td><td>35</td></tr>
<tr><td>66-70</td><td rowspan="2">Whole crop processed (e.g. alkalage)</td><td>Ear and stem yellow/golden brown, some green on nodes</td><td>Mature grains hard, difficult to split</td><td>≤ 30</td></tr>
<tr><td>71-80</td><td rowspan="2">Combinable grain</td><td>Ear and stem completely yellow/golden brown</td><td>Grains very hard, some heads bending over</td><td>> 25</td></tr>
<tr><td>>80</td><td>Ear and stem completely yellow/golden brown</td><td>Full maturity, ready to combine</td><td>< 20</td></tr>
</table>

Expected Grain: Straw Ratios

- If modest yielding crop: 50% grain and 50% straw & chaff (cut to ankle height),
- If excellent yielding crop: 60% grain and 40% straw (cut to ankle height)

Harvesting

- Harvesting should not take place until after the cereal grain has progressed beyond the milky-ripe growth stage – until it has at least reached the soft-cheddar consistency (i.e. above 35% DM).

- The crop nutritive value is effectively constant from the "soft-cheddar" stage until the cereal grain has reached the hard-cheddar consistency (approx. 55% DM) – this is a window of almost three weeks.
- A direct-cut precision chop harvester is preferable. Minimise losses during harvesting and ensiling. Trailers should have solid sides and backs to avoid grain losses.
- Crops cut with high stubble will have lower yields but higher feeding value. Crops cut with low stubble will have higher yields but lower feeding value.
- A short chop length (c. 2.5cm) will help reduce aerobic deterioration.

Ensiling

- Preservation should be straightforward. Silos need to be filled quickly.
- High DM will limit effluent discharge.
- Whole crop needs to be well-compacted and weighed down. Double sheet the pit to prevent aerobic fermentation.
- A narrow pit is preferable to reduce aerobic deterioration.
- Results from Grange indicate losses during feed-out are no greater than with grass silage, where good management practices prevail. Additives may be used where WCC silage is being used as a buffer feed in late spring or early autumn.
- The silo should be protected from wildlife such as birds, rodents etc. Laying down bait around pits is important.

Processed whole crop cereal silage

- Processed whole crop cereal silage (e.g. alkalage) is produced from cereal crops that are harvested at a minimum of 60% crop dry matter, or less than 35% grain moisture. At this stage grain fill is complete. Cereal crops can be harvested right up to the stage that the combine would enter the field.

Harvesting

- Cut the crop with a harvester fitted with a grain processor specifically installed to process / crack the grain. Harvesting can be carried out in damp or dewy conditions without significantly reducing crop DM. A level of moisture at harvest time will reduce the loss of high value flour and chaff particularly in high dry matter crops.

Ensiling

- The additive Home 'N' Dry is applied to the crop in the pit at ensiling with a fertilizer spreader. Home 'N' Dry additive is based on urea and urease enzyme.
- If harvesting is stopped for example a breakdown or harvesting over a number of days the clamp should be sheeted down to contain the ammonia which is released within 20 minutes of application to the pit.
- Processed whole crop cereal silage ensiled in this manner does not ferment, so in-storage losses i.e. heating moulds, are negligible.
- Good airtight sealing of the pit is essential to achieve good preservation.
- In general, vermin do not attack or infest the processed urea treated wholecrop.

High Moisture Grains

- As cereal grains go through the final stages of ripening and their moisture content decreases from approximately 43% to 17%, the average expected yield of grain DM starts at 7.7 t/ha and finished at 7.5 t/ha. Therefore there was a wide window where the harvested yield of grain DM was constant.
- The mean digestibility (DMD) of the harvested barley grains averages between 84% and 87% with corresponding values for the wheat of 86% and 89%.
- Protein and starch content did not change while the moisture content decreased from approximately 43% to 17%. These finding indicate that there is a wide window within which the nutritive value of the cereals grains is likely to be constant and during which the grains are really just drying.
- Once the settings on the combine-harvester and its forward speed were set appropriately, grain losses at the front of the harvester or via the straw were similar to what is achieved with conventional dry grain.
- Grain moisture content can change very rapidly when an extended period of wet weather is followed by dry weather conditions. Therefore, changes such as those highlighted above mean that the optimal window of time within which to harvest can sometimes be quite short. This can be quite restrictive and place great importance on the timeliness of harvesting.

Ensiling

- Store high moisture grain in an air-free environment and/or treat with additives that restrict mould activity. So as to maintain feed value, limit DM losses, avoid the human and livestock health challenges and avoid the animal productivity problems potentially caused by the ingested mycotoxins.
- Poorly packed processed grains are susceptible to air infiltration and thus to extensive mould growth. Thus, most processed (e.g. crimped) high-moisture grain is stored at between 30 and 40% moisture.
- Additive treatments are imposed to preserve (in particular prevent mould growth) or modify its nutritive value (e.g. disrupt the seed-coat). Among the current options are the following two main approaches:

Crimping

Organic acids (or acid mixtures) are applied to facilitate preservation and temporarily inhibit mould growth. This grain can be rolled/crimped at ensiling or at feedout - usually the former. Maintaining strictly air-free conditions throughout storage and minimising the duration of access to air during feedout is critical. The treated grain is usually sealed beneath the type of plastic used for sealing conventional grass silage.

Urea treatment

This grain is normally stored under sealed, air-free conditions (e.g. sealed beneath conventional silage plastic sheeting) to prevent the rapid loss of the ammonia produced from the urea. The ammonia prevents mould growth and when it binds with moisture in the seed coat of the grain the resultant hydroxide effect should replace the need for mechanically rolling the grain. This treatment also increases the concentration of crude protein in the grain - however, as with the other types of urea based treatments, the extra nitrogen is non-protein nitrogen and may be of limited value to the animal.

Urea +enzyme treatment

Maxammon can be used as treatment for moist grains. Moisture content of grain for treatment should be between 16 and 20%. The treated grain is alkaline (Ph 8.6-8.8). Application rate is 20 kg per ton of grain treated.

Home N'Dry is a similar urea+ enzyme treatment and grain is normally stored under sealed, air-free conditions (e.g. sealed beneath conventional silage plastic sheeting) to prevent the rapid loss of the ammonia produced from the urea. Store for 6 weeks under plastic to ensure full preservation.

Caustic treatment

Caustic soda treatment of grain disrupts the seed coat of grains, so that they can be fed to cattle without further processing. Grain harvested at the conventional stage (16-20% moisture).

- Add 3-4 tonne of grain added to the diet feeder.
- Add caustic soda to the feeder (Barley at 50 kg of caustic soda per tonne of grain, Wheat at 30 kg of caustic soda per tonne of grain).
- Thoroughly mix caustic with the grain.
- Once mixed, add water to the mixture. The level of water will depend on the moisture content of the grain and the length of the storage period.
- If the grain is to be fed fairly quickly, then enough water needs to be added to bring the moisture content up to 30%.
- If the grain is to be stored for more than 3 months then the moisture content should be brought up to 22%. It is important to allow the caustic treated grain to cool adequately before heaping it.
- Clean conditions during treatment and storage (seal tightly with a polythene sheet) are essential and conditions conducive to mould growth should be avoided

Table 3: Treatment options for high moisture grains

	Type of preservation	Grain Moisture	Processing	Machinery	Application rate
Maxammon	Urea + enzymes	16-20	Yes	Crimper	20 kg / t grain
Home N'Dry	Urea + enzymes	16-23	Yes	Crimper	30 kg / t grain
Urea	Urea	25-35	No	Wagon	15-25 kg/ t grain
Acid	Propionic Acid	35-50	Yes	Crimper	7-10 litre / t grain (increase for high moisture grain)
Caustic	Caustic	16-20	No	Wagon	50 kg/ t grain (barley) 30 kg/t grain (wheat)

KALE & RAPE

Lime

A pH of 6.5-7.0 is optimum.

Fertiliser

A NPK compound is normally broadcast at sowing and a top-dressing of nitrogen is applied when the crop is emerged. Slurry or FYM pre ploughing will normally provide enough Boron or use a fertiliser with Boron included. Kale is not as sensitive to Boron deficiency as other brassicas.

Sowing & Yields

Old (1990's) DAFM variety data for kale gives yield figures of 4 - 6 t DM/ha, however recent trial and survey work completed in Moorepark has shown that high yielding (8 -12 t DM/ha) kale crops are achievable.

Utilisation in Moorepark experiments is generally taken to be 80%. Kale needs to be sown by mid-June for high yields. Sowing date will also determine maturity. Crops take approx. 150 days to maturity. *Sow rape from July to mid-August.*

A summary of the Moorepark fodder brassica experiments is available at: www.teagasc.ie/publications/2013/2920/TResearch_Autumn2013.pdf

A fine, firm seedbed (like grass) and moisture is essential for rapid emergence as kale & rape have small seeds with low reserves. All brassicas will yield poorly where compaction has occurred. Placing some fertiliser at sowing may aide establishment.

Ploughing and powered cultivation is the surest method of establishment but in well-structured soils, direct drilling will also be successful. With direct drilling, it is essential to achieve a good weed kill with glyphosate pre-cultivation.

Kale may be precision drilled at 3kg/ha or direct drilled at 4kg/ha or broadcast usually with the fertiliser at 5-6kg/ha. Some seed merchants are recommending higher seeding rates to promote more leaf growth and less stem. *Rape is sown slightly heavier*.

Table 4: Guidelines for sowing rape and kale

Forage Crop	Sowing Date	Sowing Rate	Fertiliser Requirements at Sowing* kg/ha	Weed Control
Kale	Early May To Mid June	4.5 kg / ha	130 Kg/ha N 30 kg/ha P 170 kg/ha K + Boron	Butisan S Pre-em 1.5 l/ha. Follow label.
Forage Rape	Mid May to Mid August	6.5 kg / ha	120 kg/ha N 20 kg/ha P 50 kg/ha K + Boron	N/A

*Assumes soil index 3 for P & K, N Index 2

There is no independent data on frost hardiness but location seems to be more critical than variety based on field experience in 2009 and 2010.

Weed control

A well-established crop is critical to weed control and every effort should be made to have an excellent seed bed and vigorous early growth. Weed failures are becoming common in early sown Kale as germination may be slow and weed seeds are more likely to germinate in May than June, thus increasing weed pressure.

Remember if you are replacing silage with main crop kale – be prepared to apply the required inputs. You cannot expect reliable high DM yields from low inputs.

Perennial weeds such as Scutch grass, docks and thistles **must** be controlled by a glyphosate application pre sowing and a 'stale' seedbed may reduce weed burden.

June sowing - should not need weed control. Butisan S is cleared for use on Kale and Swedes at 1.5 l/ha. Fusilade Max 1-3 l/ha (cleared for Kale) offers control of grass weeds. Dual Gold & Lentagran have off-label clearance for Kale.

Herbicides

The following herbicides are cleared for use on kale.

- **Butisan S** at 1.5 l/ha must be applied pre-emergence and within 48 hours of sowing. Beware of heavy showers after spraying as it can reduce germination and vigour of the seedling. In 2012, the heavy rain in June 'leeched' Butisan at a critical time and some crops were severely damaged. The damage was purple kale leaves followed by dead plants.
- **Lentagran** (kale only) @ up to 2.0 kg/ha is applied from the 6 leaf stage of the kale. It can be hard on crops under stress and needs the leaves to be 'hardened-off'. It is useful where broad-leaved weeds are getting ahead of slowly growing kale. It is not label cleared for rape
- **Fusilade Max** @ 1.0-3.0L/ha (kale only) is used post-emergence and are solely for controlling grass weeds.
- ***Salsa*** *is a contact spray cleared for rape only (only herbicide approved for rape) and is good on charlock, Shepherds Purse etc.* ***It is not cleared for kale – may have crop effects.***

Pests (Kale)
Flea beetles can attack at emergence - eat small holes in the leaves. Control is rarely warranted in a fast growing crop. Control is by spraying with contact insecticide e.g. Sumi-alpha.

Diamond Back Moth is the most damaging caterpillar. It lays its eggs on the underside of each kale leaf. It is particularly damaging in warm weather. Sumi-alpha at 0.20 l/ha in 600 l/ha water will give good control. Use an organo-silicon based wetter e.g. Slippa, SW7, Breakthrough etc. A repeat application may be necessary and high water volumes are needed.
Other caterpillars (e.g. Large White) will concentrate on eating plants in a particular area of a field but control is rarely necessary.

Classical feeding (window-pane) damage from Diamond-back moth larvae in kale
Inspect crops regularly and apply a suitable insecticide as soon as damage is seen

TABLE 5: PLANT PROTECTION PRODUCTS ARE CLEARED FOR KALE 2018

Product Name	PCS no.	Function	Product name	PCS no.	Function
Amistar	05072	Fungicide	Fusilade Max	01472	Herbicide
Amistar Top	04582	Fungicide	Butisan S	04631	Herbicide
Azoshy	05618	Fungicide	Devrinol	91627	Herbicide
Azoxystar	05534	Fungicide	Stratos Ultra	04936	Herbicide
AZ-TEC	06036	Fungicide	Bonalan	05763	Herbicide
Chamane	05002	Fungicide	Lepinox Plus	05254	Insecticide
Globaztar SC	05529	Fungicide	Pyrethrum 5 EC	92317	Insecticide
Previcur Energy	04041	Fungicide	Lepinox Plus	05254	Insecticide
Score 250 EC	04566	Fungicide	Movento	04101	Insecticide
Zoxis	05348	Fungicide			

Data taken from www.pcs.agriculture.gov.ie on 20/04/2018

TABLE 6: QUICK GUIDE TO WINTER FORAGE CROPS

Forage Crop	Sowing Date	Sowing Rate	Fertiliser Requirements at Sowing* kg/ha	Weed Control	Feeding Period & yield potential
		*Assumes soil index 3 for P & K, N Index 2			
Swedes	Mid May To Mid June	3-5 kg/ha Broadcast 0.5-1.0 kg/ha precision drill	70 kg/ha N 40 kg/ha P 60 kg/ha K + Boron	Butisan S Pre-emergence only 1.5 l/ha	November to February 6-9 t DM/ha
Kale	Early May To Mid June	4.5 kg / ha Drill direct	130 Kg/ha N 30 kg/ha P 170 kg/ha K + Boron	Butisan S Pre-em 1.5 l/ha	November to February 6-9 t DM/ha
Forage Rape	Mid May to Mid-August	6.5 kg / ha Drill direct	120 kg/ha N 20 kg/ha P 50 kg/ha K + Boron	N/A	October to February 3-5 t DM/ha

Disease

Club root is the main threat but kale is not as prone as other brassicas. A one in five year rotation for brassicas is suggested to keep Club root levels low. Club root can last 20 years in soils.

Grampian and Caledonian are **tolerant** of Club Root but do not reduce the levels of the pathogen in the soil so another brassica grown in the future will suffer from the disease

Table 7: 2018 Forage Crop Margins

Variable Costs excl. VAT (€/ha)							
	F.Beet	Wholecrop W.Wheat	Wholecrop S.Barley	Kale	Rape	Arable silage *	Maize
MATERIALS	924	737	504	424	242	300	968
Seed	193	75	85	102	30	120	200
Fertilisers	456	375	278	262	212	180	398
Plastic Film	0	0	0	0	0	0	260
Sprays:							
Herbicides	205	56	45	60	0	0	110
Fungicides	30	193	91	0	0	0	0
Insecticides	40	23	5	0	0	0	0
Growth regulator	0	15	0	0	0	0	0
HIRE MACHINERY	938	603	549	210	192	495	651
Seedbed prep + sow	250	174	174	174	174	174	330
Spray	72	90	54	18	0	0	0
Fertiliser spreading	36	54	36	18	18	36	36
Harvesting	250	285	285	0	0	285	285
Washing and chopping	330	0	0	0	0		0
Interest 6%	28	30	13	12	10	10	25
TOTAL VARIABLE COSTS	1890	1370	1066	646	444	796	1644
Fresh green yield t/ha	75	37	27	50	42	35	55
Dry matter %	19	40	40	15	12	20	30
Utilisation %	90	85	85	70	70	85	85
Dry matter yield t/ha (utilised)	12.8	12.6	9.2	5.3	3.5	6.0	14.0
Dry matter cost €/tDM (utilised)	147	109	116	123	126	134	117
Cost /1,000 UFL utilised	132	136	166	110	122	191	147
Assumed UFL	1.12	0.8	0.7	1.12	1.03	0.7	0.8
*Peas 40% & barley/oats 60% mix Harvesting costs in this table are based on standard short field to yard haulage. Additional transport costs must be added for further haulage. No land charge included							