SRDP Farm Advisory Service

Forage and Grass Guide




Grass and Forage Guide

Well planned and managed forage and grassland provides an opportunity to incorporate more resilience into our beef and sheep businesses.

We are facing increased pressure on farm from the cost of inputs such as fertiliser, feed and fuel, labour shortages, emissions targets and increasing biodiversity in our cropping systems.

By looking at our forage systems on a whole farm basis and planning rotations we can increase our yield of forage grown on farm, reducing our reliance on purchased feed and reducing production costs. The strategic use of legumes can also help reduce the use of Nitrogen, lowering costs and carbon emissions.

This guide will take you through some of the options available for grass, legume, herb and forage crops, the key agronomy and management required to successful increase overall yield from forage for a beef and sheep system.

System Planning

When designing a forage system which is sustainable and profitable there are a few key areas which we must be consider to ensure the system meets our aims.

Soil Health

- The foundations for a successful forage system are optimum soil health and fertility. Regular soil tests and visual soil assessments will ensure soils are functioning for your forage system

Crop Biodiversity

- Consider whether crops can be undersown or legumes and herbs added to provide a diverse range of crops across the farm to benefit wildlife and soil health

Identify the feed gap

- Climate change is affecting seasonal growth so any forage crops grown should seek to fill the feed gap through timing of utilisation or by selecting crops suited to summer dry conditions making forage production more resilient

Soil Cultivations

- Disturbing soil has a cost in labour, fuel, emissions and loss of carbon. Consider if alternative methods of cultivations can help reduce costs, time out of production and emissions for certain crops

Purchased Inputs

- To improve efficiency the increased use of forage crops should displace other inputs such as purchased feeds – evaluate what crops will suit your system by looking at what they will reduce in purchased inputs

Crop Rotation Planning

To ensure homegrown forage is maximised it is important to identify where your feed gaps are or where an alternative forage can provide a more economic option to the current one. You should be planning more than 1 year in advance.

The rotation planner below summarises when different crops would be available to feed and the length of time those fields would be out of production.

For example if your period of greatest feed shortage is in April it may not suit to sow a full season crop such as fodderbeet but a forage rape sown after silage may suit better to minimise the land area out of production in April.

	January	February	March	April	May	June	July	August	September	October	November	December
Fodderbeet	graze	graze	graze	sow	grow	grow	grow	grow	grow	graze	graze	graze
Swedes	graze	graze	graze	sow	sow	grow	grow	grow	grow	graze	graze	graze
Kale	graze	graze	graze	sow	sow	sow	grow	grow	grow	graze	graze	graze
Forage Rape	graze	graze	out of use	out of use	sow	sow	sow	grow	grow	grow	graze	graze
Turnips	graze	graze	out of use	out of use	sow	sow	sow	grow	grow	graze	graze	graze
White clover with Grass	graze	graze	graze	graze	graze	graze	graze	graze	graze	graze	graze	graze
Red Clover with Grass	graze	graze	graze	graze	graze	graze	graze	graze	graze	graze*	graze*	graze
Multi Species Swards	Restricted use	Restricted use	graze	graze	graze	graze	graze	graze	graze	graze	graze	Restricted use

* caution with grazing sheep during tupping

Crop Options

This guide will give some information on the types of crops which may fit into a forage system, this is not a definitive list and there are many more options which can be considered depending on what you aim to achieve with your crops. The emphasis is on identifying what you want to achieve before selecting the crops which can fulfil this.

Remember to consider the infrastructure needed to get maximum utilisation from these different crops, such as water supply, shelter or power for fences.

The crops covered in this guide include:

WINTER FORAGE

Fodderbeet

Forage Brassicas

- Swedes and stubble turnips
- Kale
- Forage rape & hybrids

SUMMER FORAGE

Multi species swards

White clover

Red clover

Ryegrass

Chicory

Plantain

Arable silage

Winter Forages

Fodderbeet

- Fodderbeet is a bulb crop with the highest potential yield, which can often result in supplying the lowest cost per kg DM and MJME.
- It is highly digestible and palatable and can be used for a variety of stock classes.
- Fodderbeet (beta vulagris) is not a brassica so can be used in rotation with brassicas without risk of taking clubroot and also has a wider range of herbicides licensed for use.
- Dry matter will range between 12-19% depending on the variety of beet grown. ME and CP levels are typically between 12-13%. White flesh varieties are better suited to lifting and red and orange flesh suited to grazing in situ
- Fodderbeet is a high value crop and requires high inputs, as the yield potential is so high (15-20t DM/ha) these inputs are justified and provide a return on investment.
- Fodderbeet is sensitive to low ph and soil fertility so optimum pH should be between 6.0-6.5 and a moderate status for P&K
- It has a high potash requirement and requires two applications of Nitrogen, sodium, magnesium, boron and sulphur as part of the fertiliser programme.
- Fodderbeet is best suited to light, free draining soils and should be sown, with a precision drill into a fine firm, compaction free soil.

Fodderbeet P&K

Phosphate (kg P_2O_5/ha) and Potash Recommendations (kg K_2O/ha)

Crop	Moderate Soil P Status	Moderate Soil K status
Fodderbeet (85t FW/ha roots lifted)	60	340
Fodderbeet (grazed)	60	150

Effect of PSC on annual fertiliser requirement (kg P_2O_5/ha)

Crop	Very Low (VL)	Low (L)	Moderate (M-)	Moderate (M+)	High (H)
PSC 1	+40	+20	0	-10	-20
PSC 2	+60	+30	0	-20	-30
PSC 3	+80	150+40	+20	0	-40

Effect of soil status on annual fertiliser requirement (kg K_2O/ha)

Crop	Very Low (VL)	Low (L)	Moderate (M-)	Moderate (M+)	High (H)
Fodder crops	+60	+30	0	0	K offtake x 0.5

See Technical Note TN733 Forage Crops for Livestock for further information

Fodderbeet Fertiliser

Nitrogen N (kg/ha)

	Previous Crop/Grass Nitrogen Residue Group					
Crop	1	2	3	4	5	6
Fodderbeet (Grazed or 85t/ha roots lifted)	130	120	110	90	60	0-40*

Up to 20kg/ha of N may be needed where soil nitrogen supply is expected to be low initially, for example cold wet conditions

Other Nutrients	Application Rate/Ha
Sodium (Na)	200kg Na20 as agricultural salt
Sulphur (S)	75kg/ha SO3
Magnesium (Mg)	120kg on VL status and 80kg on L status soils
Boron (B)	2kg/ha in seedbed or foliar application

See Technical Note TN733 Forage Crops for Livestock for further information

Fodderbeet Management

- Cattle are at risk of acidosis if they eat too much fodderbeet before their rumen has adapted
- Cattle should be transitioned over a period of 3 weeks before reaching their full winter ration
- A grass headland should be allowed to provide clean lieback
- An alternative forage source such as hay or silage should always be available
- Cattle should start with 1kg DM of fodderbeet and only increase by 1kg DM every 2 days when all animals are eating
- Consistency is the key to performance – ensure once cattle are transitioned that their diet is not interrupted
- Fresh feed breaks should be provided daily to control intake with a secondary fence to prevent unlimited access if cattle break out
- Ensure the field has sufficient shelter and clean water and that there is enough space for all cattle to graze the fence line at the same time.
- Sheep are not as sensitive to fodderbeet and will generally regulate their own intake so can be transitioned over a few days. They should also be offered another forage source such as hay or silage.
- Due to the high yield of fodderbeet animals can be on a relatively small area so ensure you have a backup plan for times when weather may turn and increase the risk of soil poaching and runoff
- Ensure cattle and sheep have access to minerals or have been bolused
- Ensure all cattle and sheep have had a clostridial vaccine before grazing fodderbeet

Swedes and Turnips

- Swedes are part of the brassica family and classed as a full season root crop. With average DM yields of between 7-10tonnes DM/ha they are a high yielding crop
- As swedes are a brassica, caution must be taken with a rotation which includes other brassicas such as kale to prevent clubroot. Brassicas should not be sown in the same field on subsequent years
- Swedes should be sown in fields with good drainage and pH of approximately 6.5
- Swedes provide a similar ME to that of fodderbeet (13%) but are lower in protein at 11-12%
- Stubble turnips will have lower potential yield – 3.5-4.5tDM/ha with ME of 11% and CP of 17-18%
- Seedbed preparation and soil fertility are key as there are limited herbicide options for controlling weeds.
- Swedes have a high potash requirement and require two applications of Nitrogen, magnesium, boron and sulphur as part of the fertiliser programme.
- Swedes are best suited to free draining soils and should be sown, with a precision drill into a fine firm, compaction free soil.
- Turnips have a shorter maturation than swedes with a main crop turnip requiring a growing period of 12-15 weeks, faster maturing varieties can be grazed within 10 weeks. Stubble turnips can be classed as bulbing, which produce a smaller bulb than swedes and non bulbing which is a leafy turnip which does not produce any bulb.
- Stubble turnips are fast growing, highly palatable with high utilisation but they do not have the winter hardiness of swedes or main crop turnips.

Swedes and Turnips P&K

Phosphate (kg P_2O_5/ha) and Potash Recommendations (kg K_2O/ha)

Crop	Moderate Soil P Status	Moderate Soil K status
Swedes/Turnips (65t/ha roots lifted)	46	156
Swedes/stubble turnips grazed	25	50

Effect of PSC on annual fertiliser requirement (kg P_2O_5/ha)

Crop	Very Low (VL)	Low (L)	Moderate (M-)	Moderate (M+)	High (H)
PSC 1	+40	+20	0	-10	-20
PSC 2	+60	+30	0	-20	-30
PSC 3	+80	+40	+20	0	-40

Effect of soil status on annual fertiliser requirement (kg K_2O/ha)

Crop	Very Low (VL)	Low (L)	Moderate (M-)	Moderate (M+)	High (H)
Fodder crops	+60	+30	0	0	K offtake x 0.5

See Technical Note TN733 Forage Crops for Livestock for further information

Swede and Turnips Fertiliser

Nitrogen N (kg/ha)

	Previous Crop/Grass Nitrogen Residue Group					
Swedes/Turnips (65t/ha roots lifted)	1	2	3	4	5	6
Sands/Shallow	120	100	90	70	40	0*
Sandy Loam/other mineral	120	100	80	50	20	0*
Humose	50	40	30	20	0*	0*
Peaty	20	20	0*	0*	0*	0*
Swedes/Stubble Turnips (grazed)						
Mineral soils	100	80	60	40	0-40	0*

Up to 20kg/ha of N may be needed where soil nitrogen supply is expected to be low initially, for example cold wet conditions. For catch crops reduce nitrogen by 50-75% to account for shorter growing season.

Other Nutrients	Application Rate/Ha
Sulphur (S)	Up to 75kg/ha SO3
Boron (B)	2kg/ha in seedbed or foliar application

See Technical Note TN733 Forage Crops for Livestock for further information

Swede and Turnip Management

- Cattle and sheep do not require a strict transition onto swedes but a plentiful supply of alternative forage such as hay or silage should be on offer until they have adapted to eating the swedes fully
- A grass headland should be allowed to provide clean lieback
- An alternative forage source such as hay or silage should always be available throughout the feeding period
- Fresh feed breaks should be provided daily to manage intake and increase utilisation
- Ensure the field has sufficient shelter and clean water and that there is enough space for all cattle to graze the fence line at the same time.
- Fields which leave exposed soil after grazing are at risk of soil erosion; crops should be fed out in a way so that any sediment run off is captured in the ungrazed crop and by surrounding grass headlands. This will prevent the loss of soil and contamination of waterways with excess nutrients
- Clean water must be available at all times
- For periods when soil conditions are unfavourable, ensure you have a back up plan for times when weather may turn and increase risk of soil poaching and runoff such as straw bales to provide dry area to lie or stacked for shelter or a grass field which cattle can have access to.
- Ensure cattle and sheep have access to minerals or have been bloused
- Stubble turnips can be sown on a variety of soil types and drilled, broadcast or direct drilled until late summer as they have a shorter maturation period.

Kale

- Kale is a member of the brassica family which can achieve average DM yields of between 7-10tonnes DM/ha classing it as a high yielding leafy brassica crop
- As kales are a brassica caution must be taken with a rotation which includes other brassicas such as swedes and forage rape to prevent clubroot.
- Kale should be sown in fields with good drainage and pH of approximately 6.5
- Kale provides a typical ME of 10-11 MJ/kg/DM which is lower ME to that of fodderbeet and swedes (13%) but are higher in protein at 16-17%
- Seedbed preparation and soil fertility are key as there are limited herbicide options for controlling weeds.
- Kale has a similar phosphate potash requirement to grazed swedes and will require two applications of Nitrogen and boron as part of the fertiliser programme.
- Kale can be sown on a variety of soil types and drilled, broadcast or direct drilled.

Kale P&K

Phosphate (kg P_2O_5/ha) and Potash Recommendations (kg K_2O/ha)

Crop	Moderate Soil P Status	Moderate Soil K status
Kale (40t/ha cut)	50	200
Kale (grazed)	25	70

Effect of PSC on annual fertiliser requirement (kg P_2O_5/ha)

Crop	Very Low (VL)	Low (L)	Moderate (M-)	Moderate (M+)	High (H)
PSC 1	+40	+20	0	-10	-20
PSC 2	+60	+30	0	-20	-30
PSC 3	+80	+40	+20	0	-40

Effect of soil status on annual fertiliser requirement (kg K_2O/ha)

Crop	Very Low (VL)	Low (L)	Moderate (M-)	Moderate (M+)	High (H)
Fodder crops	+60	+30	0	0	K offtake x 0.5

See Technical Note TN733 Forage Crops for Livestock for further information

Kale Fertiliser

Nitrogen N (kg/ha)

	Previous Crop/Grass Nitrogen Residue Group					
Kale	1	2	3	4	5	6
Sands/Shallow	180	170	160	140	110	70
Sandy Loam/other mineral	120	110	100	80	50	10
Humose	70	60	50	30	0*	
Peaty	40	30	20	0*	0*	0*

Up to 20kg/ha of N may be needed where soil nitrogen supply is expected to be low initially, for example cold wet conditions

Other Nutrients	Application Rate/Ha
Sulphur (S)	Up to 75kg/ha SO3
Boron (B)	2kg/ha in seedbed or foliar application

See Technical Note TN733 Forage Crops for Livestock for further information

Kale Management

- Cattle and sheep do not require a strict transition onto kale but a plentiful supply of alternative forage such as hay or silage should be on offer until they have adapted to eating the swedes fully
- A grass headland should be allowed to provide clean lieback
- An alternative forage source such as hay or silage should always be available throughout the feeding period
- Fresh feed breaks should be provided daily to manage intake and increase utilisation
- Ensure the field has sufficient shelter and clean water and that there is enough space for all cattle to graze the fence line at the same time.
- Fields which leave exposed soil after grazing are at risk of soil erosion, crops should be fed out in a way so that any sediment run off is captured in the ungrazed crop and by surrounding grass headlands. This will prevent loss of soil and contamination of waterways with excess nutrients
- Clean water must be available at all times
- For periods when soil conditions are unfavourable ensure you have a back up plan for times when weather may turn and increase risk of soil poaching and runoff such as straw bales to provide dry area to lie or stacked for shelter or a grass field which cattle can have access to.
- Ensure cattle and sheep have access to minerals or have been bolused

Forage Rape & Hybrids

- Forage Rape and Hybrids are also members of the brassica family which can achieve average DM yields of between 3.5-4 tonnes DM/ha. Both are a leafy brassica crop
- Hybrid brassicas are a cross between a forage rape and kale and are faster growing than a kale but with a reduced yield potential. They are very palatable and have a high utilisation rate due to the narrow, palatable stems.
- Some forage rape and hybrids have the potential to be grazed twice – but only 40% of the crop should be grazed in the first grazing.
- Forage Rape and Hybrids are a brassica, caution must be taken with a rotation which includes other brassicas such as swedes and forage rape to prevent clubroot.
- Forage Rape and Hybrids should be sown in fields with good drainage and pH of 6.0 - 6.5
- Forage Rape and Hybrids provides a typical ME of 10-11 MJ/kg/DM, similar ME to that of kale but are higher in protein at 19-20%
- Seedbed preparation and soil fertility are key as there are limited herbicide options for controlling weeds.
- Forage Rape and Hybrid brassicas have a lower phosphate potash requirement to grazed swedes and kale due to its lower yield and will require up to two applications of Nitrogen and boron as part of the fertiliser programme.
- Forage Rape and Hybrid brassicas can be sown on a variety of soil types and drilled, broadcast or direct drilled until late summer as they have a shorter maturation period.

Forage Rape & Hybrids P&K

Phosphate (kg P_2O_5/ha) and Potash Recommendations (kg K_2O/ha)

Crop	Moderate Soil P Status	Moderate Soil K status
Forage Rape (grazed)	25	35
Hybrid brassica (grazed)	25	40

Effect of PSC on annual fertiliser requirement (kg P_2O_5/ha)

Crop	Very Low (VL)	Low (L)	Moderate (M-)	Moderate (M+)	High (H)
PSC 1	+40	+20	0	-10	-20
PSC 2	+60	+30	0	-20	-30
PSC 3	+80	+40	+20	0	-40

Effect of soil status on annual fertiliser requirement (kg K_2O/ha)

Crop	Very Low (VL)	Low (L)	Moderate (M-)	Moderate (M+)	High (H)
Fodder crops	+60	+30	0	0	K offtake x 0.5

See Technical Note TN733 Forage Crops for Livestock for further information

Forage Rape & Hybrid Fertiliser

Nitrogen N (kg/ha)

	Previous Crop/Grass Nitrogen Residue Group					
Forage Rape / Hybrid Brassica	1	2	3	4	5	6
Sands/Shallow	140 / 180	130 / 170	120 / 160	100 / 140	70 / 110	30 / 70
Sandy Loam/other mineral	120 / 160	110 / 150	100 / 140	80 / 120	50 / 90	10 /50
Humose	70 / 100	60 / 90	50 / 80	30 / 60	0* / 30	0* / 0*
Peaty	40 / 60	30 / 50	20 / 40	0* / 20	0* / 0*	0* / 0*

Up to 20kg/ha of N may be needed where soil nitrogen supply is expected to be low initially, for example cold wet conditions. For catch crops reduce nitrogen by 50-75% to account for shorter growing season.

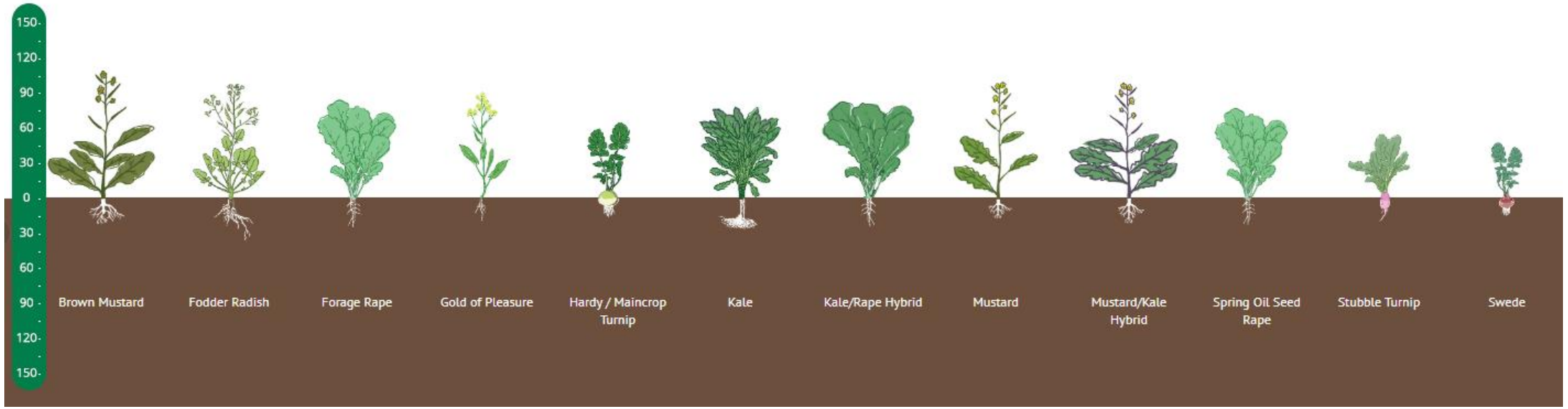
Other Nutrients	Application Rate/Ha
Sulphur (S)	Up to 75kg/ha SO3
Boron (B)	2kg/ha in seedbed or foliar application

See Technical Note TN733 Forage Crops for Livestock for further information

Forage Rape Management

- Cattle and sheep do not require a strict transition onto Forage Rape and Hybrid brassicas but a plentiful supply of alternative forage such as hay or silage should be on offer until they have adapted to eating the brassicas fully
- A grass headland should be allowed to provide clean lieback
- An alternative forage source such as hay or silage should always be available throughout the feeding period
- Fresh feed breaks can be provided daily or up to every 3 days to manage intake and increase utilisation. Due to the higher utilisation these can crops can be fed in larger blocks as well as strip grazed.
- Ensure the field has sufficient shelter and clean water and that there is enough space for all stock to graze the fence line at the same time.
- Fields which leave exposed soil after grazing are at risk of soil erosion, crops should be fed out in a way so that any sediment run off is captured in the ungrazed crop and by surrounding grass headlands. This will prevent loss of soil and contamination of waterways with excess nutrients
- Clean water must be available at all times
- For periods when soil conditions are unfavourable ensure you have a back up plan for times when weather may turn and increase risk of soil poaching and runoff such as straw bales to provide dry area to lie or stacked for shelter or a grass field which cattle can have access to.
- Ensure cattle and sheep have access to minerals or have been bolused before grazing the crop

Rooting Depth of Brassicas



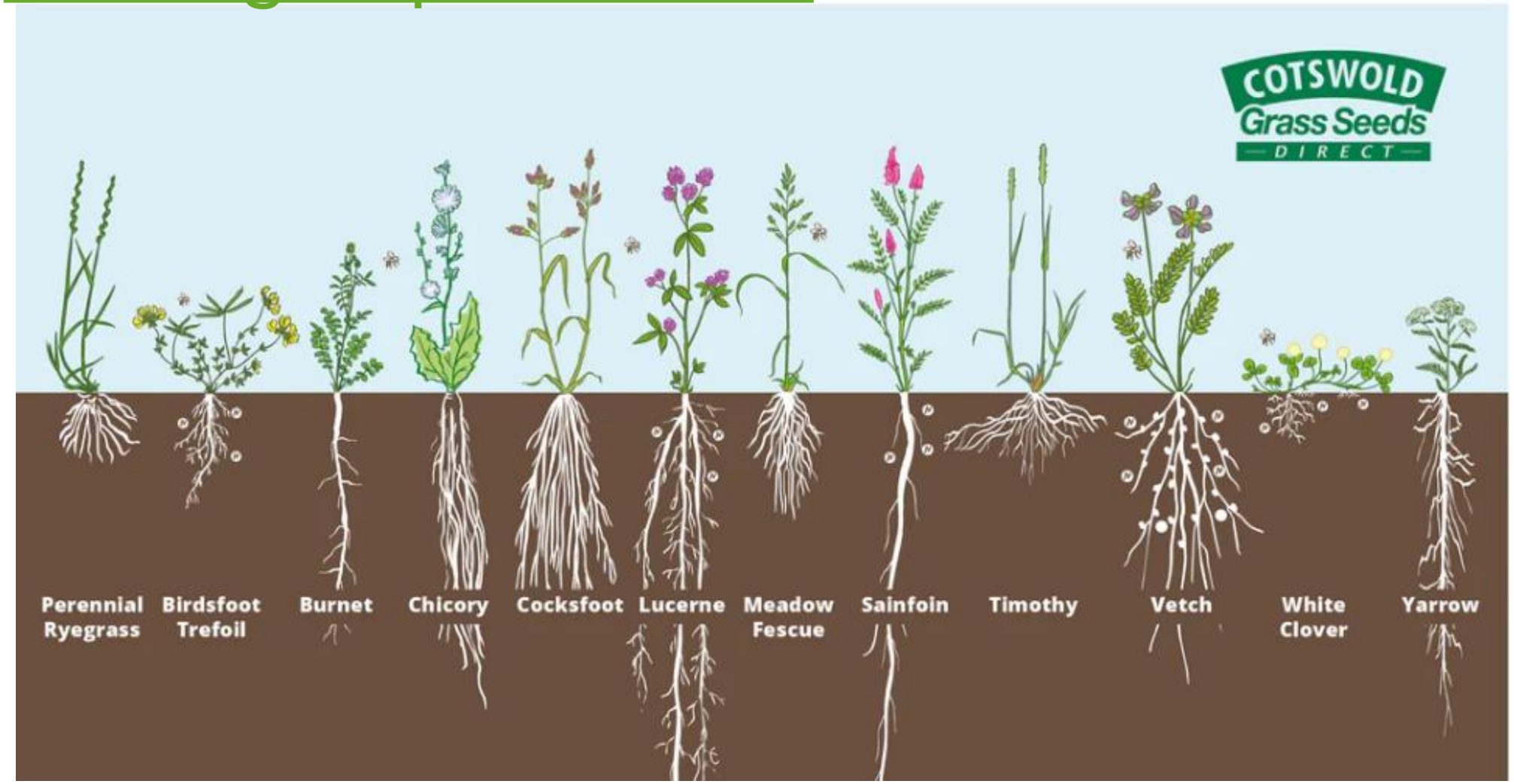
Variations in rooting depth of brassicas can assist with soil structure by creating gaps in the structure for water and air to move through. Source www.cotswoldseeds.com

Summer Forages

Multi Species Swards

- Multi Species swards (MSS) is the term given to swards with many different plant species contained.
- MSS typically contain some perennial ryegrass, white clover, red clover, chicory and plantain but can include many more species such as sainfoin, timothy, cocksfoot, birdsfoot trefoil and creeping red fescue.
- MSS provide a source of pollen and nectar for insect, small mammals and birds
- The high legume content of the sward reduces need for nitrogen
- Sensitive to intense grazing so must be rotationally grazed and rested through winter months
- MSS contain a mix of plant species, typically herbs, legumes and grasses at varying proportions and provide plants which have different rooting depths which can access minerals lower in the soil profile resulting in higher macro mineral and trace element levels in the pasture.
- Chicory has anthelmintic benefits and as part of a mixed sward can provide a higher ME (12.6% v 12%) and CP (23% v 9%) content than grass and white clover alone. (Figures from trials at SRUC.)
- Herbs will not persist for as long as perennial ryegrass and white clover so the proportion of herbs and legumes may reduce over a period of 3-4 years, however the ryegrass and native grasses will in persist where herbs do not.
- Best suited to free draining soils with pH 6.0-6.5 and moderate P&K levels
- Deep rooting plants will assist with drought tolerance during summer
- No herbicide options for weed control so consider stale seedbed establishment

Rooting Depth of MSS



Variations in rooting depth of legumes, herbs and grasses can assist with soil structure by creating gaps in the structure for water and air to move through. Source www.cotswoldseeds.com

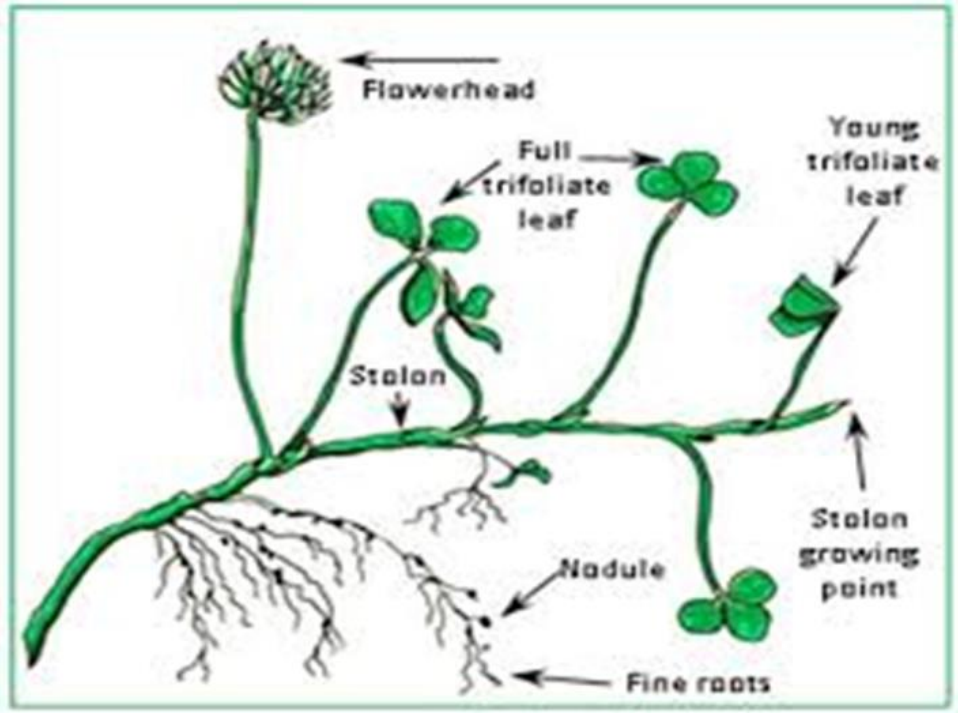
MSS Management

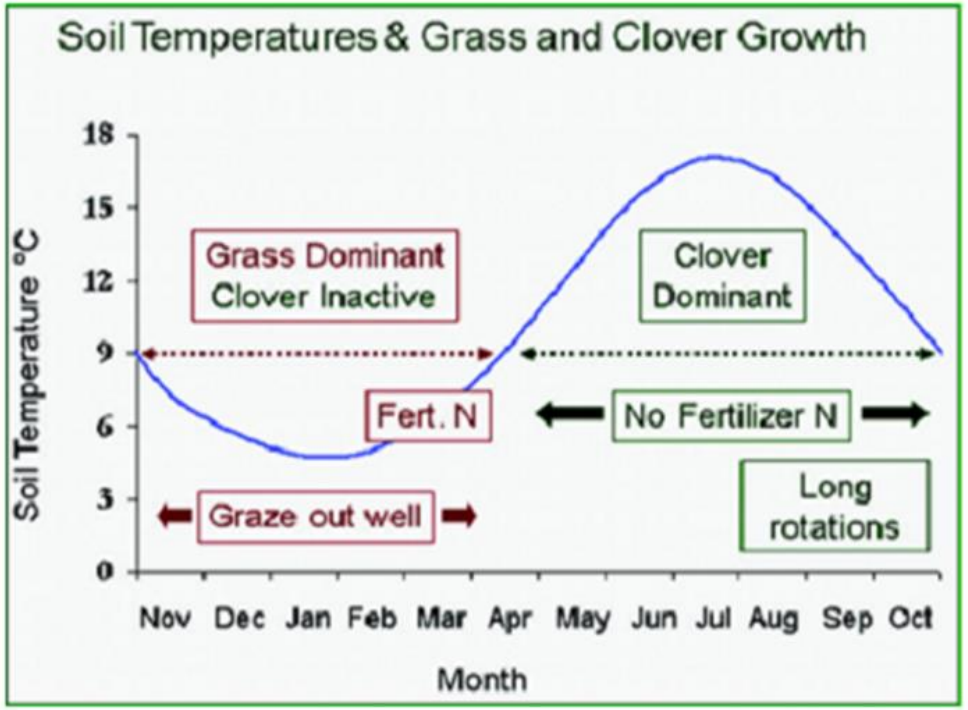
- For best results swards should be rotationally grazed
- A grass cover of 4-6cm of grass should be maintained throughout the winter to protect clover stems and stolons from frost damage
- Avoid grazing in wet conditions as poaching can damage the crown on chicory plants, reducing persistence
- Allow flexibility with grazing to reduce paddock size or increase numbers during periods of high growth to prevent herbs flowering
- A rest period of 21-28 days will be required to allow species to recover between grazing and promote persistence
- Moving stock every 1-3 days will reduce the selective grazing of most palatable herbs and legumes which can result in reduced persistence from over grazing
- Monitor clover content and graze intensively then rest if more clover required or use Nitrogen if clover content considered too high and stock at risk of bloating
- Monitor soil P&K levels with soil sampling

White Clover

- White clover is a perennial legume capable of fixing nitrogen. Rhizobium bacteria on the clover root nodules allow it to take Nitrogen from the atmosphere and convert it into a form which can be taken up by plants. It can fix between 100-250kg N /ha /Yr (dependant on inorganic N use and clover content in sward)
- White clover comes in 3 leaf sizes, with small and medium sized leaf varieties suited best to grazing and medium and large leaf varieties suited to cattle grazing and cutting
- White clovers spread through creeping stolons which have increased tolerance of grazing and winter hardiness
- Clover is highly digestible so animals preferentially graze it D value can be up to 5% higher in white clover than ryegrass
- White clover is more tolerant to dry conditions and will grow at higher soil temperatures and can maintain growth through warm summers
- White clover typically has CP content of 27% in comparison to ryegrass at 17%
- It maintains leaf and nutritious value at a time when grass plants are seeding and reducing in feed quality. Key minerals such as calcium, phosphorous copper and selenium are also greater in clover plants than in ryegrass alone
- White Clover is quite resilient and provided it receives enough sunlight in the Spring and adequate soil fertility and conditions it will persist for many years.

White Clover





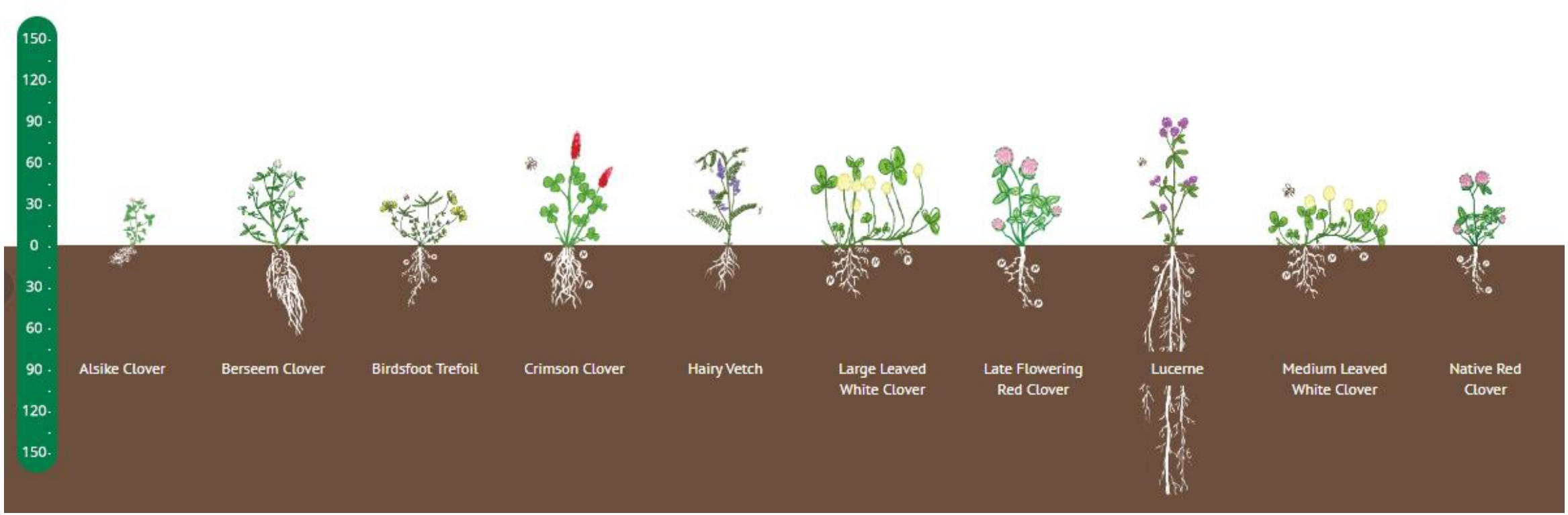
- Nodules on white clover root hairs take in N from the atmosphere and convert to plant available N
- New roots are formed from stolons, which spread along the surface of the ground

- White clover is slower to start growing in the Spring than ryegrass but will reach peak growth from June – Sept
- If clover content is low increased grazing pressure can allow sunlight to base of sward to encourage clover or if content is too high N fertiliser can be used to reduce risk of bloat

White Clover Management

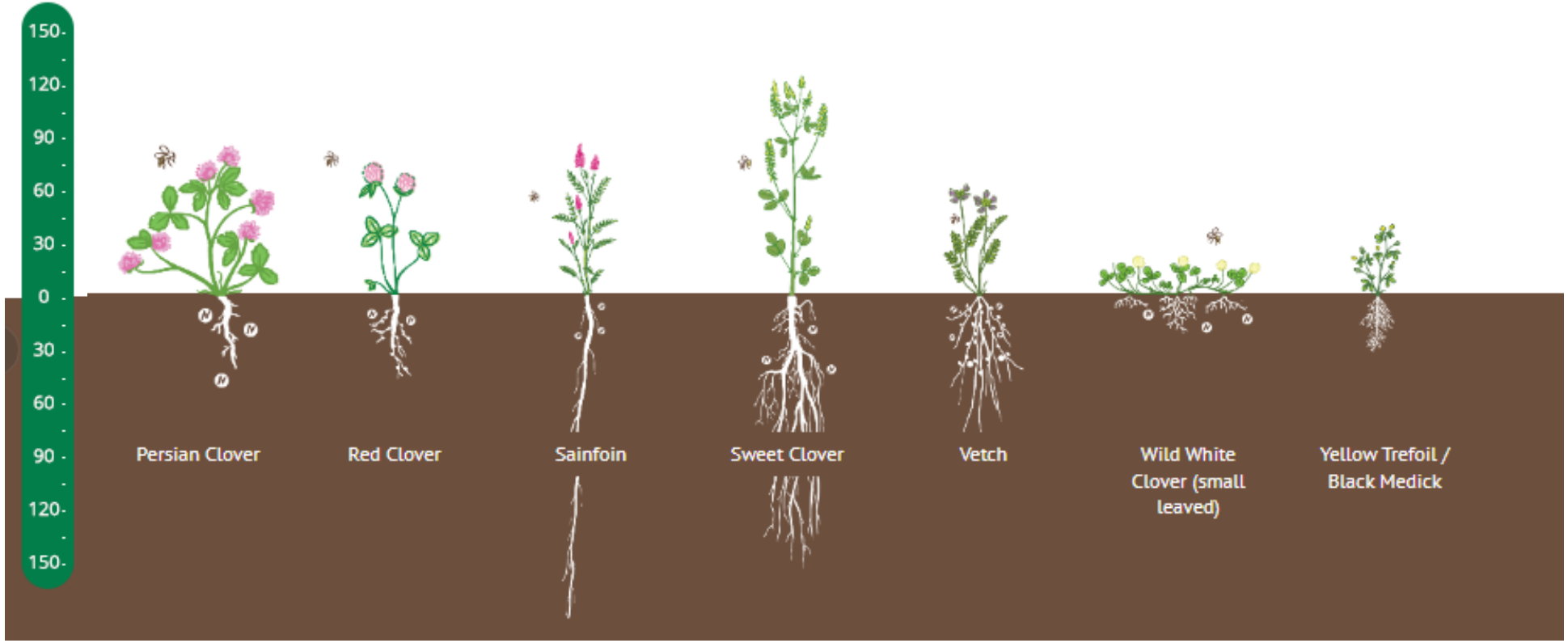
- Aim to maintain a dry matter balance of 30% white clover to 70% as an average throughout the season to maximise the best of the clovers nutritional and nitrogen fixing ability without posing health risks to cattle
- White clover will not start growing until soil temperatures are above 8$_{o}$C in the Spring - manage grass canopies during this period to ensure clover plants receive enough sunlight at the base of the sward when they start emerging
- White clover is sensitive to low pH and K deficiency – maintain soil pH between 6-6.5 and P and K at a moderate status
- Monitor the size and vigour of stolons in the Spring to determine whether clover needs to encouraged or strategically managed. Use intensive grazing with sheep, artificial N or less frequent cutting to reduce clover growth is it becomes dominant.
- Avoid poaching swards as this will damage the stolons of the clover and affect growth
- Select small leaf varieties in grass mixtures for grazing
- Use medium and large leaf varieties for cutting and cattle grazing
- Keep grass sward at a height of 4-6cm during winter to protect the clover stolons from frost damage
- Oversowing existing swards with white clover over a number of years can help encourage a high clover content
- When grazing red clover swards ensure measures are taken to reduce the risk of bloat

Rooting Depth of Legumes



Variations in rooting depth of legumes can assist with soil structure by creating gaps in the structure for water and air to move through. Source www.cotswoldseeds.com

Rooting Depth of Legumes

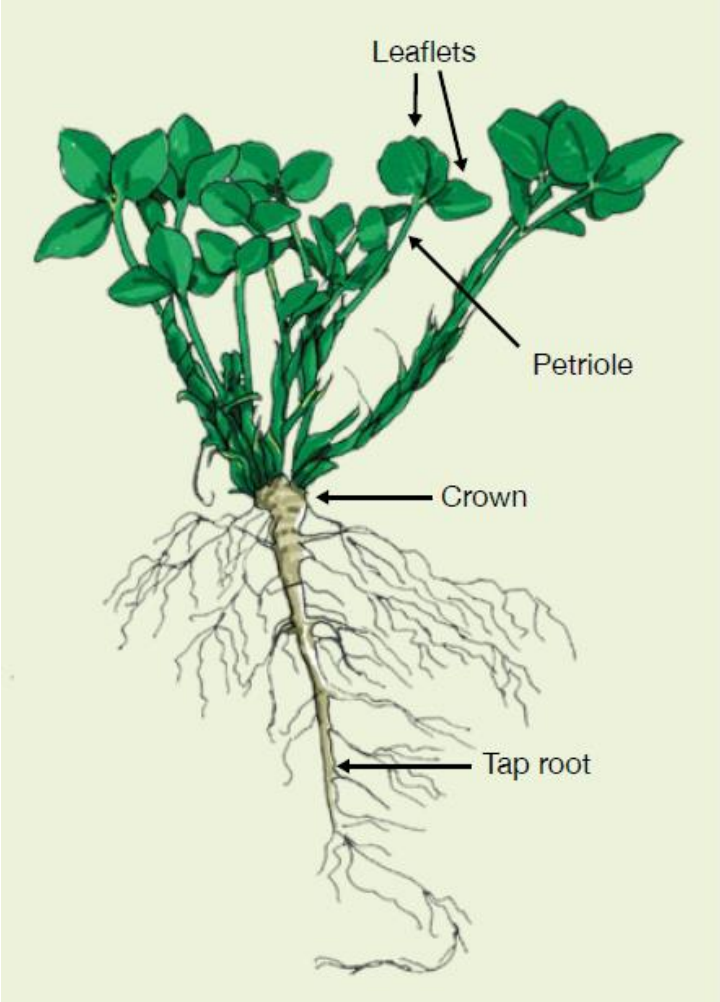


Variations in rooting depth of legumes can assist with soil structure by creating gaps in the structure for water and air to move through. Source www.cotswoldseeds.com

Red Clover

- Red clover is a perennial legume - it is less persistent than white clover with modern varieties lasting up to 5 years.
- Red clover has a tap root and grows from a crown at the base of the stem. Nutrients are stored in the crown.
- Red clover is most commonly used for silage swards due to the potential for improved quality of silage through increased CP content
- Red clover has a lower CP content than white clover but the enzyme polyphenoloxidase protects the protein so less protein is lost during silage making. Red clover CP is typically 14-19%
- Red clover has an upright growth habit and is suited to a grass mixture containing shorter term grasses such as Italian and hybrid perennial ryegrass
- When grown with a companion grass the fixated N can be utilised by the grasses
- The rooting structure and depth of red clover assists with improving soil structure and soil nutrient status
- Red clover is sensitive to low pH, soils should be maintained between a pH of 6.0-6.5
- Phosphate and Potash applications should be matched to replace offtakes made from silage
- Red clover can affect the fertility of ewes when grazed during mating due to the presence of phyto-oestrogen.

Red Clover



- The crown holds nutrients for the plant but can be prone to damage if grazed intensively or cut for silage below 8cm
- Deep tap root assists with drought tolerance by scavenging for water and nutrients
- Deep tap root also helps to penetrate soil structure creating space for nutrients and water to move through
- Red clover is best suited to free draining soils
- Red clover can be sensitive to low pH soils and low fertility (P&K)

Red Clover Management

- If using red clover for cutting cut when between 30–50% of flowers show red for optimum quality
- Do not cut below 8cm to avoid damaging the crown
- Nutrients are held within the leaves, once cut avoid tedding to minimise leaf shatter
- Silage aftermath should be grazed lightly in the Autumn and not grazed below 6cm. A grass cover of 4-6cm should be maintained during winter to protect the crown from frost damage
- Monitor clover content of sward to prevent bloating risk in cattle
- Nitrogen should not be applied after the establishment phase of red clover unless grass is showing signs of being N deficient in the early Spring
- Avoid grazing or using heavy machinery during wet conditions to prevent damage to the crown of red clover plants
- Phosphate and Potash applications should be made according to offtakes and soil status
- When grazing red clover swards ensure measures are taken to reduce the risk of bloat such as supplementing water supplies

Ryegrass

- Modern ryegrasses are high yielding and very responsive to inputs such as Nitrogen
- Grazing a ryegrass plant when it has 3 live leaves will provide the optimum balance between yield, high quality feed and promoting grass regrowth.
- Ryegrasses can be grown in a variety of soil types and with adequate fertility can be tolerant to drought and waterlogging
- Few other crops are as versatile as ryegrass and grow all year round under certain conditions
- Compatible with many other species such as legumes and herbs to increase diversity
- There have been 60 years of breeding programmes selecting for specific traits in ryegrasses
- Tolerant of intensive grazing
- With careful management very persistent

Choosing the right Ryegrass

1. There are 4 species of ryegrass – categorised by their persistence. The growth habits and persistence of each species and should be considered depending on the purpose of your reseed

Perennial	Hybrid	Italian	Annual
• Persist for 5 years or more • Easy to establish • Reliable • Highly palatable • Easy to manage • Highly productive • Best suited with white clover • Best for mid season digestibility	• Persist for 2-5 years • Derived from crossing perennial ryegrass with Italian ryegrass or similar • Better cool season growth than PRG • Highly productive • Good companion with red clover for silage	• Persist up 2-3 years • Higher yielding • Better cool season growth • Can be difficult to manage with peaks in growth • Fast establishment • Good companion for red clover	• Persist up to 1 years • Higher yielding in short period • Can be difficult to manage with peaks in growth • Useful as nurse crop for grass reseed

Choosing the right Ryegrass

2. Within species of ryegrass, plants can be either a diploid or tetraploid. This refers to the number of chromosomes within a plant and affects growth habit, persistence and palatability and should be factored in when looking at the varieties within your grass mixture to ensure the mix is suited to the purpose it is intended. Tetraploid varieties should be marked with a T beside them on recommended lists.

Diploid

- Diploids have more tillers per plant
- Higher DM content due to less water per cell
- Slightly lower ME

- Robust and can tolerate more intense grazing
- Less prone to pugging

Tetraploid

- Tetraploids have more chromosomes than diploids
- Bigger cell size so hold more water and have lower DM content

- Higher ME
- More palatable = higher DM intakes
- Better utilisation
- More open swards
- More likely to poach

Choosing the right Ryegrass

4. Grasses are grouped as Early, Intermediate or Late varieties depending on their heading date. The heading date is the date on which 50% of the ears in fertile tillers have emerged. The actual heading date will vary according to the growing season and altitude but the relative order of varieties heading will remain constant.

Early

- Grow earlier in the Spring
- More erect growth habit
- Fewer tillers and easier to cut for silage
- Typically head in first two weeks in May

Intermediate

- Persistent
- High quality mid season feed
- Best suited in mixes with late varieties for high quality forage
- Typically head second two weeks in May

Late

- Prostrate growth habit
- Most persistent
- Late season high quality feed
- Typically head first two weeks in June

Other grasses

Grass	Benefits	Weaknesses
Cocks foot	Drought, flood and frost tolerant. Early season growth. Deep rooting	Can become unpalatable if not cut or grazed frequently
Festulolium (ryegrass x fescue)	Resilient to frost, drought or waterlogging. High yielding. Palatable. Deep rooting	Shorter term grass.
Smooth stalked meadowgrass	Nutritious and palatable. Persistent. Early spring growth. Grazing tolerant	Lower yielding
Timothy	Persistent. Winter hardy. Early spring growth. Tolerant of various soil conditions and intense grazing	Slow in first year of production
Creeping Red Fescue	Tolerant of cutting and grazing. Provides a good sole to a sward with its creeping rhizome growth habit.	Lower yielding. Can out compete other grasses

Grassland P&K

Phosphate and Potash recommendations for established grassland

Utilisation	Yield (t/ha)	P content (kgP_2O_5/t)	P offtake ($kg\ P_2O_5/t$)	K content ($kg\ K_2O/t$)	K offtake ($kg\ K_2O/t$)
Silage – 1st cut	12-23	1.7	20-39	6	72-138
Silage – 2nd cut	7-12	1.7	12-20	6	42-72
Silage – 3rd cut	6-9	1.7	10-15	6	10-54
Hay @ 86% DM	7	5.9	41	18	126
Grazing @ 15-20% DM	10	1.4	3*	4.8	2*
Haylage @ 45% DM	4	3.2	13	10.5	42

Yields and offtakes based on typical range. Silage based on fresh weight – 25% DM

*Under grazing it is assumed 80% of P_2O_5 and 95% of K_2O is recycled infield by animal dung and urine

Phosphate and Potash recommendations for grass establishment (spring and autumn)

Crop	Very Low (VL)	Low (L)	Moderate (M-)	High (H)	Very Low (VL)	Low (L)	Moderate (M-)	High (H)
Grass with high clover, red clover	150	110	70	50	130	90	70	40
All other management	130	90	50	30	110	70	50	20

Grassland P&K

Effect of soil status on annual fertiliser requirement (kg P_2O_5/ha) – established grass

Crop	Very Low (VL)	Low (L)	Moderate (M-)	Moderate (M+)	High (H)
Grass with high clover, red clover	+80	+40	0	0	P offtake x 0.75
All other management	+80	+40	0	0	P offtake x 0.5

Effect of PSC on annual fertiliser requirement (kg P_2O_5/ha) – established grass

Crop	Very Low (VL)	Low (L)	Moderate (M-)	Moderate (M+)	High (H)
PSC 1	+40	+20	0	-10	-20
PSC 2	+60	+30	0	-20	-30
PSC 3	+80	+40	+20	0	-40

Effect of soil status on annual fertiliser requirement (kg K_2O/ha) – established grass

Crop	Very Low (VL)	Low (L)	Moderate (M-)	Moderate (M+)	High (H)
Grass with high clover, red clover	+60	+20	0	0	K offtake x 0.5
All other management	+60	+20	0	0	K offtake x 0.5

See Technical Note TN726 Fertiliser recommendations for grassland for further information

Grassland Fertiliser

Nitrogen N (kg/ha)

	Site Class				
Grass Management	1	2	3	4	5
2 or 3 cut silage + grazing	310	300	290	280	270
1 cut silage + grazing	280	270	260	250	240
Grazing with low clover	270	260	250	240	230
Hay + grazing	220	210	200	190	180
Grass with high clover (20-30% clover mid season)	100	90	80	70	60

Levels of N use may be lower than figures shown dependant on level of intensity and production required on farm
Conservation figures based on uptake of 2.5kg N/ha per day

Site Classes

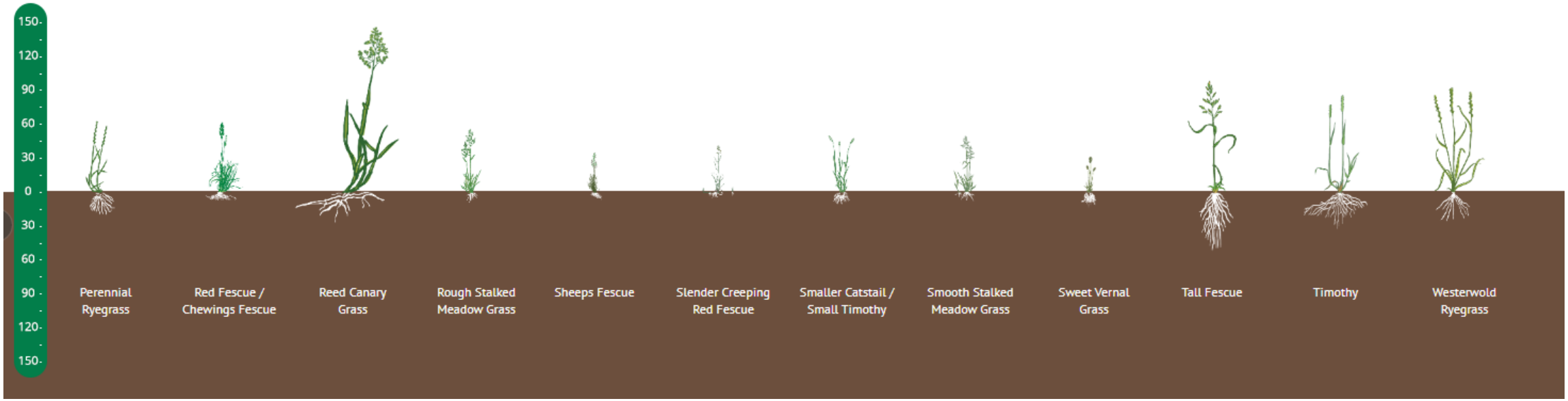
Soil texture	Average April –September rainfall (mm)*			
	More than 500	425-500	350-425	Less than 350
	Site Class **			
Sands and shallow soils	2	3	4	5
All other soils	1	2	2	3

*Approx 50% annual rainfall
**Add 1 for farms above 300m

See Technical Note TN726 Fertiliser recommendations for grassland for further information

Rooting Depth of Grasses

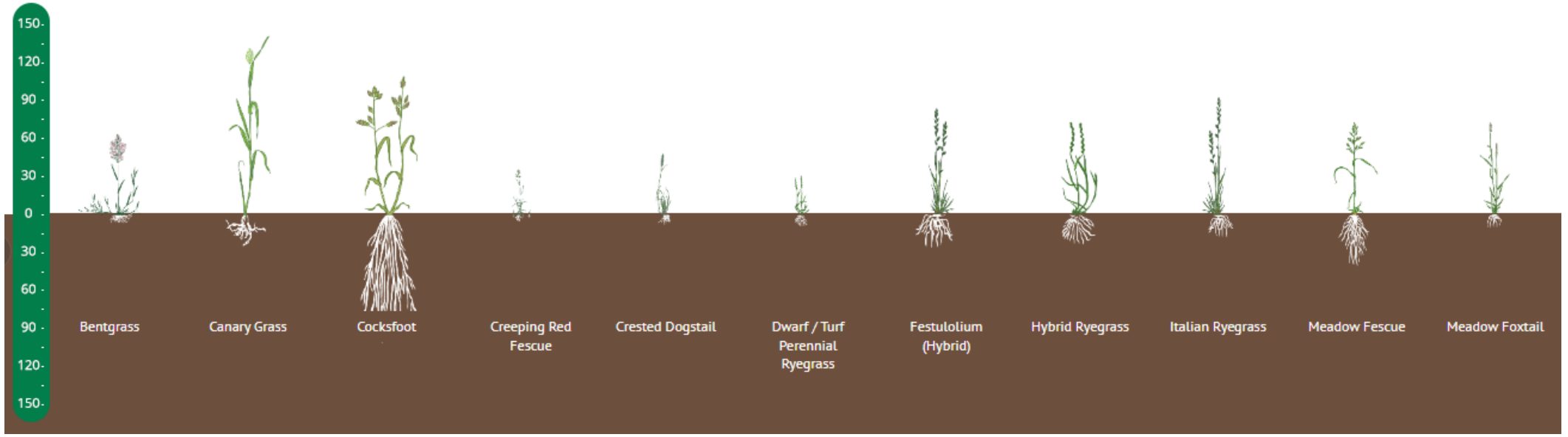
Whilst modern perennial ryegrasses form the base of our grass based systems in Scotland there are other species of grasses which can be included in mixtures for their rooting structures, tolerance to wet or dry conditions and feed quality. The following charts demonstrate the different rooting depths that grasses will work at.



Variations in rooting depth of grasses can assist with soil structure by creating gaps in the structure for water and air to move through. Source www.cotswoldseeds.com

Rooting Depth of Grasses cont.

Whilst modern perennial ryegrasses from the base of our grass based systems in Scotland there are other species of grasses which can be included in mixtures for their rooting structures, tolerance to wet or dry conditions and feed quality. The following charts demonstrate the different rooting depths that grasses will work at.

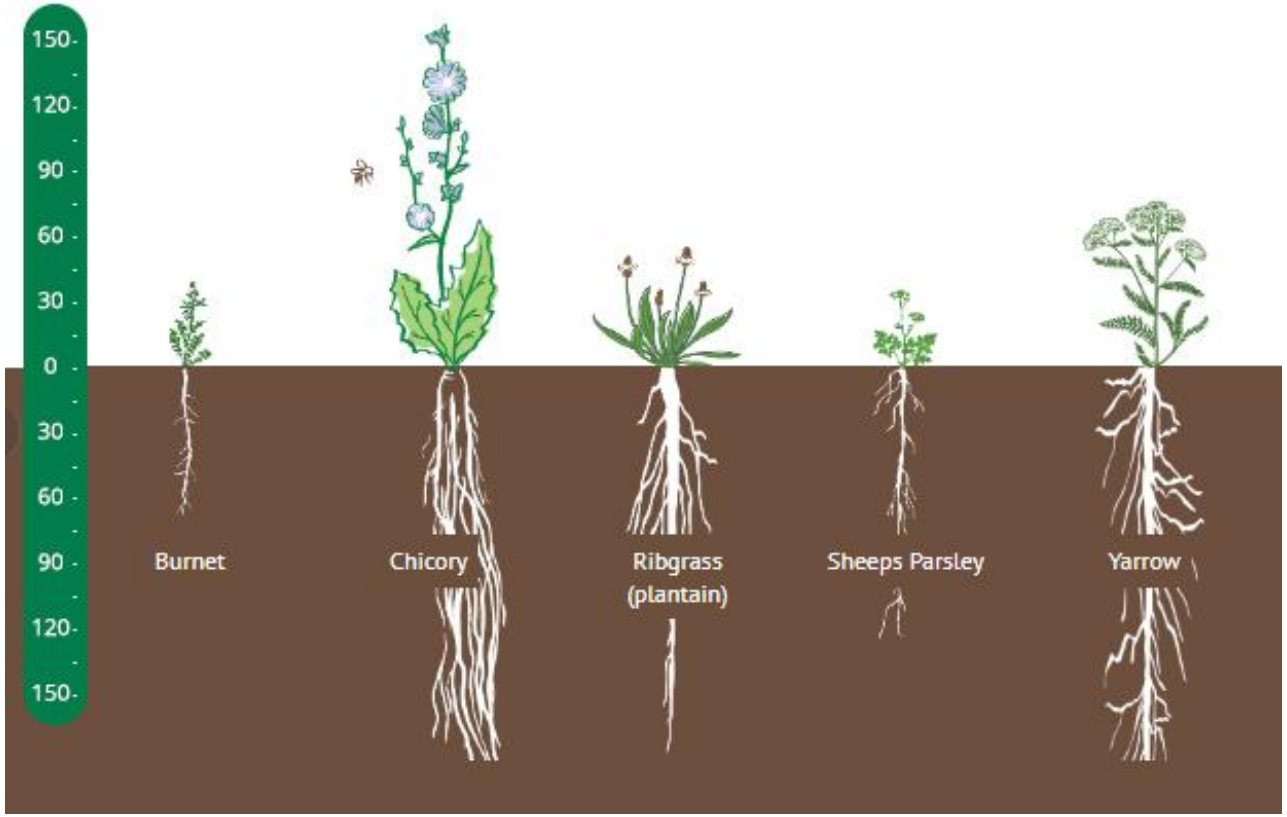


Variations in rooting depth of grasses can assist with soil structure by creating gaps in the structure for water and air to move through. Source www.cotswoldseeds.com

Chicory

- Chicory is a perennial herb with a deep tap root
- Chicory produces a high yield during summer months and is a high quality feed (12.8 ME and 17-18 CP)
- Deep tap root gives drought tolerance, aids drainage, breaks up compaction and aids soil aeration
- Likes free draining soils
- There are no options for post emergence weed control using herbicides so sowing into optimum conditions is essential. Ensure pH is between 6.0-6.5, with moderate P&K status and soil temperature are above 12 degrees and rising before sowing as chicory can be slow to establish
- Chicory will typically persist for 3-4 years depending on grazing management
- Chicory should be rotationally grazed with a rotation of 21-30 days
- Over grazing will reduce the persistence on the chicory
- Plants should be grazed when around 20-30cm high and stock removed with a target residual of 7-8cm. If plants are left unmanaged the stem can be quite woody and unpalatable
- Chicory will not tolerate hard grazing through the winter months so should be rested before grazing again in Spring – it should not be grazed below 5cm in Autumn and Winter
- Chicory is higher in calcium, sodium, magnesium and potash than perennial ryegrass
- Chicory is a herb so requires Nitrogen for extra growth but when grown as mixture with legumes such as white and red clover they can provide the Nitrogen for growth

Rooting Depth of Herbs



Variations in rooting depth of herbs can assist with soil structure by creating gaps in the structure for water and air to move through whilst foraging deeper for nutrients and water during dry periods. Source www.cotswoldseeds.com

Plantain

- Plantain is a perennial herb with a deep tap root
- Plantain produces a higher yield during early spring and summer months then perennial ryegrass and is a high quality feed with protein content of around 20%
- Deep tap root gives drought tolerance, aids drainage, breaks up compaction and aids soil aeration
- Likes free draining soils – does not like waterlogged or deep sand soils
- There are no options for post emergence weed control using herbicides so sowing into optimum conditions is essential. Ensure pH is between 5.6-6.5, with moderate P&K status and soil temperature are above 10 degrees and rising before sowing
- Plantain will typically persist for 3-4 years depending on grazing management
- Plantain should be rotationally grazed with a rotation of 21-30 days
- Over grazing or competitive grasses will reduce the persistence on the plantain
- Plants should be grazed when around 20-30cm high and stock removed with a target residual of 5-8cm. Plantain is more palatable than chicory when flowering so if often selective grazed if grazed under set stocking conditions.
- Plantain will not tolerate hard grazing through the winter months so should be rested before grazing again in Spring – it should not be grazed below 5cm in Autumn and Winter
- Plantain is higher in calcium, sodium, magnesium, Zinc, Selenium and potash than perennial ryegrass
- Plantain is a herb so requires Nitrogen for extra growth but when grown as mixture with legumes such as white and red clover they can provide the Nitrogen for growth

Arable Silage

- Arable silages can be grown from a variety of cereal, legume and grass crops such as wheat, oats, barley, triticale, lupins, vetch and peas
- Arable silages can provide a valuable source of protein and starch to be fed throughout the winter
- If undersown they can also provide a nurse crop for the establishing grass
- When undersowing with grass seed rates of the cereal mix should be lowered to avoid outcompeting the grass
- Herbicide applications will be restricted when legumes are sown so alternative weed control methods will need to be adopted
- Early harvesting leaves flexibility for building late summer and Autumn grass or following with stubble turnips or multi species sward

Arable Silage P&K

Phosphate (kg P_2O_5/ha) and Potash Recommendations (kg K_2O/ha)

Crop	Moderate Soil P Status	Moderate Soil K status
Spring Cereals (25t/ha)	45	135

Effect of PSC on annual fertiliser requirement (kg P_2O_5/ha)

Crop	Very Low (VL)	Low (L)	Moderate (M-)	Moderate (M+)	High (H)
PSC 1	+40	+20	0	-10	-20
PSC 2	+60	+30	0	-20	-30
PSC 3	+80	150+40	+20	0	-40

Effect of soil status on annual fertiliser requirement (kg K_2O/ha)

Crop	Very Low (VL)	Low (L)	Moderate (M-)	Moderate (M+)	High (H)
Fodder crops	+60	+30	0	0	K offtake x 0.5

See Technical Note TN715-718 Phosphate and potash recommendations for crops grown in your area for further information

Arable Silage Fertiliser

Nitrogen N (kg/ha)

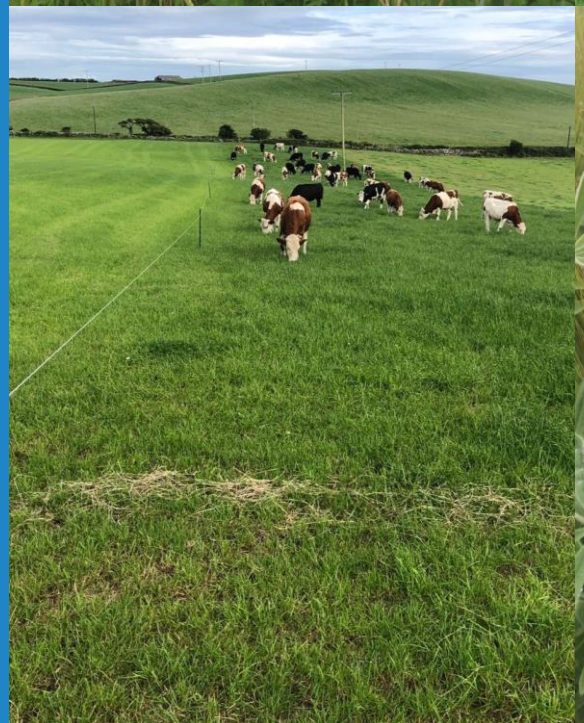
	Previous Crop/Grass Nitrogen Residue Group					
Spring Barley	1	2	3	4	5	6
Sands/Shallow	150	140	130	110	80	40
Sandy Loam/other mineral	130	120	110	90	60	20
Humose	80	70	60	3040	10	0
Peaty	50	40	30	10	0	0
Adjustments for rainfall – winter rainfall (1st Oct - 1 Mar) over 450mm						
Sands, sandy loam, shallow soils	0	+10	+20	+20	+20	+200
All other soils	0	+10	+10	+10	+10	+10

Reduce N rate by 25kg/ha if undersown
Reduce N rate by 30kg/ha for spring oats
Reduce N rate by 1.5kg/ha/day for each day of delay after 10 days after your optimum sowing date

Other Nutrients	Application Rate/Ha
Sulphur (S)	Up to 75kg/ha SO3
Boron (B)	2kg/ha in seedbed or foliar application

See Technical Note TN731 Nitrogen recommendations for cereals, oilseed rape and potatoes for further information






Further Reading

- Outwintering Strategies for Livestock
- Forage First Sheep Systems
- Technical Note TN733 Forage Crops for Livestock
- Technical Note TN759 Grass and Clover Varieties 2021-22
- Technical Note TN736 Optimising the Application of Livestock Manures
- Technical Note TN734 Fertiliser Recommendations for Vegetables, Minority Arable crops and Bulbs
- Technical Note TN726 Fertiliser Recommendations for Grassland Scotland
- Technical Note TN721 Soil Biodiversity and Soil Health
- Technical Note TN714 Liming Materials and Recommendations
- Technical Note TN694 Alternative Forage for Sheep – Fodderbeet
- www.fas.scot

Previous crop groups

Group	Previous Crop
1	Spring barley, spring oats, spring rye, spring wheat, winter barley, winter oats, winter rye, winter wheat, whole crop, triticale, carrots, shopping swedes, turnips (human consumption), linseed, onions, asparagus, radish, narcissus, tulip, swede/turnips (stockfeed), parsnips, ryegrass (seeds)
2	Forage maize, forage rape, green manure crop, kale cut, winter oilseed rape, spring oilseed rape, hemp, courgette, beetroot (red baby, other), potatoes (<60 days, seed and punnets), potatoes (60-90 days, seed and punnets), potatoes (60-90 days, ware) potatoes (90-120 days), potatoes (>120 days), blackberries, loganberries, blackcurrants, redcurrants, blueberries, tayberries, strawberries, raspberries 1-2 year low N leys and not grazed within 2 months of ploughing out or during Sept/Oct
3	Harvested fodder (root only), beans (broad), beans (dwarf/runner), beans (field vining), vining peas, combining peas, lupins, leeks, lettuce, rhubarb, uncropped 1-2 year low N leys and grazed within 2 months of ploughing out during Sept/Oct 1-2 year high N leys and not grazed within 2 months of ploughing out or during Sept/Oct Thin, permanent grass, low N, no clover
4	Grazed fodder, turnips grazed, kale grazed, forage rape grazed, chicory pure stand grazed 1-2 year high N leys and grazed within 2 months of ploughing out or during Sept/Oct 3-5 year low N leys and not grazed within 2 months of ploughing out or during Sept/Oct Thick, permanent grass, low N
5	Leafy brassica vegetables, leafy non brassica vegetable, brussels sprouts, cabbage (all types), calabrese (broccoli), cauliflower 3-5 year high N leys and not grazed within 2 months of ploughing out or during Sept/Oct 3-5 year low N leys and grazed within 2 months of ploughing out or during Sept/Oct Permanent grass, high N, not grazed within 2 months of ploughing out or during Sept/Oct
6	3-5 year high N leys and grazed within 2 months of ploughing out Permanent grass, high N, grazed within 2 months of ploughing out
Low N means less than 150kg/ha/yr fertiliser N used on average in last 2 year High N means more than 150kg/ha/yr fertiliser N used on average in last 2 years or high clover content	