Planting and Growing Miscanthus

Best Practice Guidelines **July 2007**

For Applicants to Defra's Energy Crops Scheme

Contents

1. Glossary of terms

Defra	Department for Environment Food and Rural Affairs
DTI	Department of Trade and Industry
ECS	Energy Crop Scheme
ERDP	England Rural Development Programme
ha	Hectare
kg	Kilogram
MJ	Mega-joule (one thousand joules)
MW	Mega-watt
MWe	Mega-watt electrical capacity
NFFO	Non-Fossil Fuel Obligation
Rhizome	Modified underground stem used for crop propagation
odt	Oven dry tonne
Soil Diffuse pollution	A pollution event from a series of non point source pollution events over a catchment area. Examples are sheet run off from fields or seepage of nutrients from soil into ground water.

2. Introduction

This booklet is designed to introduce farmers to the energy crop miscanthus and is intended to offer guidance for planting which takes place for agreements under the ERDP 2000 - 2006. Although this scheme has now closed, planting may take place after 2006 as part of a staged establishment if this was agreed in your original offer letter. It gives guidance on the most appropriate location, land preparation, planting techniques and crop management required to grow miscanthus as a crop destined for energy use (or for other uses). The booklet summarises ongoing current research and best commercial practice. This is the second version, and will be further updated as greater experience is gained, so it is advised that you check that you have the latest version of the booklet. This booklet should be read in association with the Energy Crop Scheme Explanatory Booklet. For further copies and latest updates, please visit our website at: www.defra.gov.uk/erdp/schemes/energy

3. Why grow energy crops?

The market for energy crops - crops which are grown specifically to be harvested and burnt in power stations, combined heat and power (CHP) units or heating systems - is increasing. This is in response to a number of power and heat projects developed and developing across England which utilise biomass, including energy crops. One such crop is miscanthus. Defra and the Government as a whole are keen to encourage sustainable and responsible growth in the energy crop market in response to the need for atmospheric carbon dioxide (CO_2) abatement. Government targets,

aspirations and long-term energy policy were contained in the Energy White Paper published in 2003.

Alongside wind and other forms of 'renewable energy' the UK Government identifies biomass-derived energy as one of the ways that it can achieve its obligations to the Kyoto Climate Change Protocol of reducing greenhouse gas emissions by 12.5% relative to 1990 levels. In addition the Government has committed to curbing UK CO_2 levels by 20% by 2010 and by 60% by 2050. The UK has a domestic target to generate 10% of the nation's electricity from renewables by 2010, rising to 20% by 2020. These targets could mean the generation of 1,000 MWe from renewable energy sources by the year 2010, with a significant amount coming from biomass derived power plants. Biomass can also be burnt to produce heat, at a range of industrial or domestic scales.

Miscanthus can be used to produce heat, CHP or electricity power on a range of scales from large power stations (30 MW+) requiring hundreds of thousands of tonnes of biomass annually, to small-scale systems (on-farm or single building) requiring just a few dozen tonnes during winter months. Advice on grants for capital expenditure on biomass systems is obtainable from a range of sources listed at the back of this booklet.

Grants to assist in the establishment of this crop have been available from Defra under the Energy Crops Scheme (ECS), part of the England Rural Development Programme (ERDP). A second round of Energy Crops Scheme establishment grants for 2007-2013 has been announced and is expected to open in late summer 2007. A second Bioenergy infrastructure Structure Scheme Grant was announced in the 2006 Climate Change Review. The aim of the grant will be to facilitate the development of the supply chain required to harvest, store, process and supply biomass to heat, combined heat and power and electricity end users. Details will be available on the Defra website at http://www.defra.gov.uk/farm/crops/industrial/energy/infrastructure.htm when the scheme becomes live.

Full details of the grant schemes can be found in the ECS booklets 'Establishment grants for short rotation coppice and miscanthus' at www.defra.gov.uk/erdp/schemes/energy.

4. Alternative end uses

Other markets for miscanthus exist apart from that for the energy market. Other end-uses include high value equine bedding and sustainable composite materials for markets such as the production of biodegradable plastics and fibres for car parts. New markets continue to develop and it is possible that in the future transport fuels such as ethanol and even hydrogen may be produced from biomass crops such as miscanthus**.** To explore further markets it is worth visiting The National Non Food Crops Centre www.nnfcc.co.uk.

5. What is miscanthus?

Miscanthus species are woody, perennial, rhizomatous grasses, originating from Asia which have the potential for very high rates of growth. Miscanthus may be familiar to many as a flowering garden ornamental, but it is the sterile, hybrid forms that are of value agriculturally.

Miscanthus growing in the UK

Miscanthus is planted in spring and once planted can remain in the ground for at least fifteen to twenty years. First year growth is insufficient to be economically worth harvesting. New shoots emerge around March each year, growing rapidly in June-July, producing bamboo-like canes. The miscanthus dies back in the autumn/winter, the leaves fall off, providing nutrients for the soil, and the canes are harvested in winter or early spring.

This growth pattern is repeated every year for the lifetime of the crop, and the annual harvest gives an annual income to the farmer.

Miscanthus spreads naturally by means of underground storage organs known as rhizomes. However, their spread is slow and there is little risk of uncontrolled invasion of hedges or fields. These rhizomes can be split and the pieces re-planted to produce new plants. All propagation, maintenance and harvest operations can be done with conventional farm machinery, but dedicated miscanthus planters produce the most even establishment. Semi-automatic potato planters can also give excellent results.

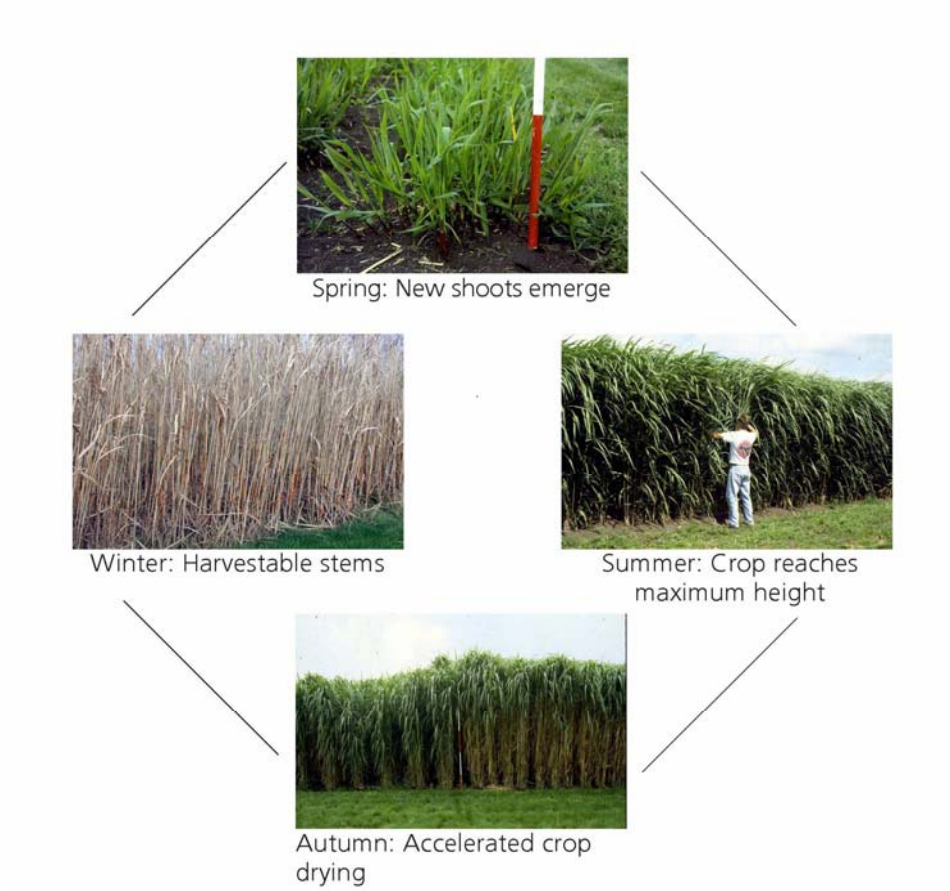
In the UK, long-term average harvestable yields from a mature crop (i.e. excluding the first 3 years – see section on yield), have exceeded 16 oven dry tonnes per hectare per year (odt/ha/yr) at the most productive experimental

sites. These high yields suggest that the crop has the potential to make an important contribution to the UK's commitments to energy generation from renewable sources since 22,000 tonnes of miscanthus can provide enough electricity to power 2,000 homes.

6. Annual growing cycle

The growth pattern of the crop is simple. It produces new shoots annually and these usually emerge from the soil during March. These shoots develop into erect, robust stems, which reach 1 - 2 m in height by late August of the year of planting, with a diameter of 10 mm. The stems, which have an appearance similar to bamboo canes, are usually unbranched and contain a solid pith.

Annual growing cycle



From late July the lower leaves start to dry. Crop drying accelerates during autumn, as nutrients move back to the rhizome. Leaves then fall and a deep leaf litter develops. Most remaining foliage dies following the first air frost, and the stems dry to a relatively low moisture content (30 - 50%) during winter. By February, free standing, almost leafless, canes remain and it is these which are harvested mechanically, when their moisture contents have often fallen significantly. This growth cycle is repeated once spring-time

temperatures increase again. From the second season onwards the crop can be expected to achieve a maximum height of 2.5 - 3.5 m.

7. Where to grow miscanthus?

Crop requirements

Climate

Miscanthus yields have been modelled in England since the 1990's. Key determinants of yield are sunshine, temperature and water availability. Annual variability in these factors result in annual yield variations. For any particular site micro-climatic conditions such as aspect will also affect annual yield. Harvestable yields in England vary on average between about 12 t/ha to around 16 t/ha.

Soils

Miscanthus has been reported growing, and producing high or reasonable yields on a range of soils, from sands to high organic matter soils. It is also tolerant of a wide range of pH, but the optimum is between pH 5.5 and 7.5. Miscanthus is harvested in the early spring. The fallen leaf material and the rhizome mat below the soil surface provide very stable ground conditions for harvesting. Soil diffuse pollution should be controlled by ensuring soils retain good structure and compaction is minimised. Further guidance can be found in Cross Compliance Guidance for Soil Management.

Temperature

The potential cropping zones for miscanthus are widespread. Miscanthus does not grow at temperatures below a threshold of 6^{o}C. This is considerably lower than for maize and therefore the potential growing season is longer. Late spring frosts which destroy early spring foliage and effectively reduce the duration of the growing season are the major constraint to long season growth.

Water availability

Annual rainfall and soil water retention will strongly influence the yield of miscanthus at any site. Miscanthus possesses good water use efficiency when considered on the basis of the amount of water required per unit of biomass and miscanthus roots can penetrate and extract water to a depth of around 2m. However, to achieve high yields miscanthus may need more water than the crops that it may replace. In addition, a dense canopy means that 20-30 % of rainfall is intercepted by, and evaporates off, the leaves and never reaches and infiltrates into the soil. Limited soil water availability during a growing season will prevent the crop from reaching full potential yield in that year; a loss of 90 kg of biomass per ha for each millimetre of soil water deficiency has been calculated. Irrigation is not justified due to the cost and the current value of the biomass obtained. In times of severe drought, the foliage of miscanthus will first show leaf rolling and then die back from the leaf tip. This will reduce yield in the year of drought but in all cases experienced in the UK to date the crop will survive and re-grow the following year.

Site selection
A site must meet the requirements of the ECS which can be found in Section 1 of the Establishment Grants ECS booklet. Applications for the ECS must be linked to an energy end use (either on or off-farm) that is within reasonable distance of the crop.

The Forestry Commission will visit the site to assess how the crop will:

Appear in the landscape: Since the miscanthus will exist on the site for at least 15 to 20 years and can reach up to 3.5m in height, its impact on the local landscape (particularly if the site is close to a footpath) or an adjacent landowner needs to be considered.

Affect any existing semi-natural habitats*:* Care must be taken to prevent plantations from adversely affecting existing conservation areas or species of conservation concern in the area. These issues are discussed in more detail in the 'environmental considerations' section of this booklet.

Affect any archaeological features*:* Deep fibrous roots may damage such features, and sensitive areas should be avoided, or included in the open ground allowance.

Some eligible land for the ECS can remain uncropped with miscanthus, and can help accommodate landscape and access issues, with no impact on the amount of grant awarded and including any phased planting under that agreement. Where appropriate open ground can be positioned alongside neighbouring houses to protect their view. Including uncropped open ground without loss of grant means that headlands, Public Rights of Way and Archaeological features can be safeguarded. Eligible open ground areas include:

- Working margins (>3 metres to allow for machinery to turn)
- Rides (4 to 6 metres wide usually every 500 metres)
- Archaeological sites
- Hedge buffer strips (>3 metres wide)
- Semi-natural habitats
- Water sides (3 to 20 metre buffer depending on the water course)
- Public Rights of Way (must be kept clear: > 5 metres wide)
- Land adjacent to neighbouring land where views may be compromised (at least 10 metres)
- Way leaves: 5-6m strip beneath power lines may be treated as open ground

8. Planting

Pre-planting requirements
Thorough site preparation is essential for good establishment, ease of subsequent crop management and high yields. As the crop has the potential

to be in the ground for at least 15 years, it is important that it is established correctly to avoid future problems.

The first step, in the autumn before planting, is to spray the site with an appropriate broad spectrum herbicide (e.g. glyphosate) for controlling perennial weeds. On some sites it may be necessary to sub-soil to remove compaction, then plough and left to over-winter. This will allow frost activity to break down the soil further. This may also help prevent 'ley' pests such as the larvae of two moths; the common rustic moth and the ghost moth attacking the newly established plants, as any larvae or eggs already in the soil from the previous crop will have insufficient food over the winter to survive. On light soils it may be more appropriate to spring plough.

In the following spring the site should be cultivated immediately prior to planting. This will improve soil aeration and establishment by aiding good root development. Rolling, post planting, will also improve soil root contact and the effectiveness of any residual herbicides applied.

Planting material

Using high quality cutting material is essential to obtaining good establishment. Rhizomes should be purchased from dedicated nursery fields of miscanthus, and be of a young age class, and not taken from old cane crops. Sensitive handling and transport of the rhizomes prior to planting is also essential to ensure viability. For plant health reasons, miscanthus rhizomes should only be sourced from European countries.

Methods of propagation

The main method of propagation currently used in the UK is rhizome division, although micro-propagation is another method that could be used.

Rhizome division is favoured because it is less expensive and generally produces more vigorous plants. To produce new planting material, two or three-year-old plants are split whilst dormant, using a rotary cultivator, and the rhizome pieces collected for re-planting.

Micro-propagated miscanthus

Miscanthus rhizomes

Rhizome pieces must have at least 2 to 3 ‘buds’ and must be kept moist before re-planting. This is best achieved by keeping rhizomes under cold-storage conditions (<4^{o}C), but they will remain viable in the field for a short period of time, if stored in a heap and covered with moist soil.

Planting density
Rhizomes need to be planted to allow for some expansion of the plant during the life of the crop and at a soil depth of 5-10 cm. Planting densities vary from 10,000 to 15,000 or more rhizomes per hectare, and it is best to seek advice from your supplier or contractor as to the appropriate density for your fields.

The initial planting density allows for some establishment losses while still providing the plant density of approximately 10,000 /ha - required to achieve optimal yields from year three onwards and effective weed suppression through competition.

The optimal planting time for rhizomes is from March to April and this is strongly recommended as early planting takes advantage of spring-time soil moisture and allows an extended first season of growth. This is important, because it enables larger rhizome systems to develop. These are more robust in future years, and allows the crop to tolerate drought and frost better. Planting can continue into May and even early June, but is not encouraged as soil moisture will be lower, and the planting operation could result in the destruction of nests of ground nesting birds if any are present.

Planting equipment
There have been significant developments in miscanthus planting technology in the past few years. Previously, broadcast planting using a manure spreader followed by cultivation and rolling was general practice. While this method produces a fast work rate, it is not recommended because of the unpredictability of plant spacing and low establishment rates sometimes associated with it. Therefore, use of a bespoke planter is recommended, although a potato planter can be used, and the rhizomes may need to be graded. More detail is given below - work rates reported are averages and will vary according to site conditions.

***Specialist miscanthus planters*:** Several types of automatic two and four row planters have been developed in the UK, and are in commercial use. These can establish crops at between 10 – 20 ha per day, and planting density can be controlled. Generally these planters can achieve greater establishment success than potato planters, and are available for use from several UK companies. For further information on specific designs, refer to the contact details provided at the back of the booklet.

Modular potato planter: For rhizomes destined for use in a manually fed potato planter, grading is required to remove rhizomes which will not pass down the

planting tube or have less than 2-3 ‘buds’. The work rate achieved is low (0.3 ha day) but might still be suitable for planting small areas.

9. General crop management

Fertiliser requirement

The annual fertiliser demands of the crop are very low, due to good nutrient use efficiency and the plant’s ability to re-cycle large amounts of nutrients into the rhizomes during the latter part of the growing season. As a consequence, nutrient off-take at harvest is low. Since the leaves predominately remain in the field it is only necessary to account for the amount of nutrients removed in the stems. The nutrient requirements during the following seasons are met by leaf litter decomposition, natural soil nutrient reserves, rhizome reserves and atmospheric depositions. Mature rhizomes tend to store more nutrients than the crop needs, so after the first 2 years, only a small quantity of additional micro-nutrients may be required. For good miscanthus yields a minimum phosphorus and potassium soil index of 1 should be aimed for. Nitrogen may also be applied. However, it is worth noting that over 13 years of field research on miscanthus at Rothamsted Research in the East of England has revealed no yield response to nitrogen.

When nutrients are needed in the first 2 seasons, these can be supplied from farm-yard manure, sewage sludge or other organic manure with a low available nitrogen content. This is of particular benefit on light soils where it will increase moisture retention and improve the condition of the soil. The DEFRA Code of Good Agricultural Practice for the Protection of Water (1998) should be followed and where appropriate Nitrate Vulnerable Zone Regulations and The Sludge Use in Agriculture Regulations must be adhered to when applying organic manures. The reference section lists where to obtain these documents from.

Weed control

Weeds compete with the crop for light, water and nutrients and can reduce yields. A wide range of herbicides have been used effectively to control weeds - with no visible damage to the crop. Suppliers of miscanthus propagation material are able to supply recommendations for safe and effective weed control.

Weed control in the establishment phase of the crop is essential, because poor control can severely check the development of the crop. **It is vital that proposed sites should be cleared of perennial weeds before any planting takes place.**

Following the establishment year, a spring application of a broad-spectrum herbicide may be needed to control grass weeds such as common couch and annual meadow-grass and broad-leaved weeds with early season vigour.

Timing this application for the dormant period between harvest and initiation of spring growth is crucial - and extreme caution is needed as it will cause severe damage to any new shoots which might have emerged.

Once the crop is mature (i.e. from the summer of the second or third year, depending on site and climate), weed interference is effectively suppressed, initially by the leaf litter layer on the soil surface and subsequently by the closure of the crop canopy, which reduces the light penetrating into the under-storey. Weeds that do survive offer little competition to the crop.

Defra's Pesticides Safety Directorate has given off-label approval for herbicides used for cereals, grass and maize to be used on miscanthus. Visit: http://www.pesticides.gov.uk/psd. Since there are no label recommendations, all products are used at the users own risk. Herbicide application must not be made on miscanthus crops greater than one metre in height and the crop cannot subsequently be used for food or feed.

Pests and diseases

Miscanthus species are susceptible to pests and diseases in the areas to which they are native (Asia) but, as yet, none of these has been reported in the UK. Stem basal diseases may infect stems in the autumn or winter, reducing stem strength. There are no reported insect pests in Europe that have significantly affected the production of miscanthus. However, two 'ley pests', the common rustic moth and ghost moth larvae feed on miscanthus and may cause problems in the future:

The common rustic moth
The larvae feed from autumn until May on miscanthus grass roots and other grasses including cock's-foot. The larvae can also damage young miscanthus shoots in the spring. These larvae overwinter before becoming adults, concealed in ground vegetation by day, becoming active after dark. They are particularly attracted to flowers of the common ragwort and marsh grasses.

The ghost moth
Ghost moth larvae are subterranean and rarely seen, feeding on roots and rhizomes of miscanthus and other grasses. It takes two years to develop into a moth, thereby over-wintering twice. Ghost moth adults are often found in grassy embankments, fields and hillsides. The males can often be in flight at dusk on warm evenings amongst tall grassy vegetation.

10. Harvesting

The annual harvest of the stem material is possible from late February until early May, with the later harvest giving the driest stems. For energy cropping, a dry, baled product is the most desirable. However, care should be taken not to disturb nesting birds when harvesting.
The crop is first cut with a forage harvester into a swath.

Then the crop is baled. There are a number of different types of balers, each producing different bales (e.g. rectangular, round and compact rolls), suitable for different scales of energy combustion. Large rectangular and round balers are capable of producing bales with a dry matter density of between 120 and 160 kg/m^3 and weighing between 250 and 600 kg. These balers generally have a capacity of 1 ha/hr.

Miscanthus being baled

Miscanthus baler

A critical factor for an energy crop is the moisture content at harvest. The drier the crop, the higher the energy yield and bale value. Moisture contents as low as 15% have been obtained in the UK, with the maximum being about 40%. By conditioning and allowing to dry in the field in windrows, the stem moisture content can be halved.

Storage

The storage of miscanthus bales should follow the same rules as the handling and stacking of any bales produced in agriculture. For more details refer to Handling and Stacking Bales in Agriculture by Health and Safety Executive (details of where to obtain this can be found in the reference section). The correct siting of the bale stack is important to reduce the Health and Safety risk and to ensure good fuel supply logistics. Thus stacks should be sited;

- Away from public roads and footpaths to reduce the risk of fire from discarded cigarette ends,
- Away from overhead power lines,
- Well away from residential properties and where several stacks are sited together they should be built in a line across the prevailing wind and not less than 24 meters apart.

All stacks must not be higher than 1.5 times the shortest baseline measurement. Bales should be stacked on the unstrung sides and overlap bale layers must be included at regularly intervals, as well as binding in the vertical columns.

Covering the bales will limit degradation and biomass losses, and keep the fuel dry. Covering can be either plastic sheeting, or bale stack sheets (available from good agricultural suppliers) – which are stronger and easy to secure using the attached guy ropes.

11. Calendar of activity

	Year	Period	Activity
PREPLANTING	-1	Jan - Jun	• Consider site selection and liaise with neighbours, local authorities, archaeologists, etc. • Prepare evidence of market for miscanthus • Prepare and submit Defra Establishment Grant application
		Aug – Nov	• Herbicide application for control of perennial weeds • Add phosphate (P) and potassium (K) fertiliser but only if required [typically ploughed in] • Plough
ESTABLISHMENT	1	Jan – Apr	• Spring plough on light soils. • **Planting**
		Apr – May	• Apply additional nutrients but only if required • Herbicide application while crop height below 1m
	2	Feb – Mar	• First year growth not usually harvested
CROPPING		Apr – May	• Apply additional nutrients e.g. nitrogen (N), but only if required • Herbicide application while crop height below 1m
	3+	Feb – Mar	• **Harvest** previous years growth with forage harvester • Bale and stack
		Apr – May	• Monitor crop nutrient and apply nutrients if required

12. Yield

Yields will vary according to age of the crop and environmental factors specific to any one particular site. The crop will take three years to reach a mature yield (up to five years on marginal sites). After this initial yield-building phase, the crop will continue to be productive for many years (at least 15 years).

Yield as plants mature

The yield from the first season's growth, at 1-2 t/ha, is not worth harvesting. The stems do not need to be cut and so may be left in the field until the following season. However, if spring-time applications of translocated herbicides are planned then the miscanthus stems should be cut-back in order to reduce any risk of crop uptake. From the second year onwards the crop could be harvested annually, if sufficient yield.

The second year harvestable yields may range usually from 4-10 t/ha and those in the third year would be between 10 -13 t/ha or more. Harvestable yields reach a plateau after 3-5 years usually on average reaching from 12 to 16 t/ha. The reasons for the variation in the yield building phase duration and yield in the plateau phase depends on planting density, soil type and climate. At sites where moisture supply or exposure limits yield, there may be a longer 'yield-building' phase.

Long term yield

Sites to be approached with some caution are upland (over 300 m) and sandy soils, where yields could potentially be lower (although this may not always be the case). Your rhizome supplier should be able to advise on the suitability of an individual site in terms of potential yield production. The overall economic viability of the crop will depend on the type and proximity of the end-use.

Removal of miscanthus

Miscanthus can easily be removed from an existing site by the application of a post-emergence non-selective herbicide such as glyphosate, followed by normal cultivation such as ploughing. Continuous mowing can be used as an alternative to using a non-selective herbicide to kill the miscanthus (this exhausts the rhizome).

13. Energy value

Miscanthus has a net calorific value, on a dry basis, of 17 MJ/kg. The energy value of 20 t of dry miscanthus would be equivalent to that of 8 t of coal. Growing miscanthus as a fuel is very energy efficient.

Miscanthus can be used for a range of end-uses - from co-firing in coal power stations, to large-scale electricity power stations and for small scale heat production. Existing straw burning technology can be used to meet on-farm heat requirements.

Drax Power Station in Selby, North Yorkshire where substantial quantities of miscanthus are contracted with local farmers for co-firing

14. Environmental considerations

Several completed studies and on-going research have demonstrated that compared to arable or intensive grass which miscanthus is most likely to replace, the impact is likely to be benign.

Low input:
Compared to arable crops, miscanthus has a very low agro-chemical requirement. Use of pesticides other than herbicides and chemical fertilisers are not recommended. As the site is only cultivated once, at establishment, reductions in soil disturbance and erosion can also be achieved compared with conventional arable crops .

Carbon savings:
Miscanthus takes up as much carbon as is released when it is burnt so there is no net increase in CO_2 into the atmosphere. Some additional carbon is sequestered in the soil from root and rhizome growth. Carbon budgets which include the use of fossil fuels in the transportation of materials indicate that the entire cycle releases less carbon than when compared with fossil fuel combustion cycles. Miscanthus should be grown close to its end use to reduce energy use which would result from shipping this bulky material large distances.

Landscape:
Care should be taken when choosing a site to plant miscanthus – as discussed in the 'site selection' section. Careful siting of open ground can minimise impacts, for example having open ground at field margins adjoining neighbours land.

Biodiversity:
Research in the UK on the impacts of miscanthus on biodiversity is ongoing. Research completed so far has shown that it can enhance biodiversity for a

range of wildlife including for certain reed nesting birds, earthworms, spiders and mammals compared with growing winter-sown cereals[1,2].

Cover for wildlife

Miscanthus provides cover for most of the year because, although the crop is harvested annually, it is harvested shortly before the following year's growth begins. This cover can act as a wildlife corridor linking existing habitats such as crop margins, woodlands and hedgerows. For example, miscanthus is grown on several shooting estates for its value as a game cover crop and nursery for young pheasants and partridges.

A recent study showed there to be an immediate benefit to biodiversity due to providing an over winter site for birds, small mammal and invertebrates[3].

However, this work has been carried out on young miscanthus plantations. Work on mature well established miscanthus plantations has yet to be completed which we hope will give us a clearer picture of the impacts of miscanthus on biodiversity.

Game cover:

Nest of reed warbler in miscanthus

[1] Jodl, S, Eppel-Htz A and Marzini K (1998) Examination of the ecological value of Miscanthus expanses - faunistic studies. In: biomass for Energy and Industry; Proc 10th EU Bioenergy Conference, Wuzburg, Germany Carmen Publishers, Rimpar, Germany pp 48-53.

[2] Christian D G, Bullard M J and Wilkins C (1997) The agronomy of some herbaceous crops grown for energy in Southern England. Aspects of Applied Biology. 49 Biomass and Energy Crops pp41-51.

[3] The effects of energy grass plantations on biodiversity. DTI Report: CFP 374/22

15. Contacts

For more information on the Energy Crops Scheme, contact your local **Natural England office.** To find the address and telephone number visit http://www.defra.gov.uk/erdp/regions/default.htm

Policy for Energy Crops Scheme
DEFRA
Crops for Energy Branch
Area 4b
Nobel House
17 Smith's Square
London SW1P 3JR
Tel 020 7238 6307
Visit www.defra.gov.uk/erdp/schemes/energy for information on the Energy Crops Scheme.

Suppliers of planting material, equipment and advice.

- ADAS Renewable Energy www.adas.co.uk, 01354 692531
- BICAL www.bical.co.uk, 01884 35899
- John Amos & Co: www.johnamos.co.uk, 01584 831134

Contacts for advice

- Biomass Energy Centre www.biomassenergycentre.org.uk
- Department for Trade and Industry (DTI): www.dti.uk/energy/renewables/support
- The Carbon Trust: www.thecarbontrust.co.uk
- The National Non Food Crops Centre www.nnfcc.co.uk
- Rothamsted Research: www.rothamsted.ac.uk
- The Game Conservancy Trust: www.gct.org.uk/
- Community Renewables Initiative: www.countryside.gov.uk/LAR/Landscape/CRI/Index.asp
- Renewables East: www.renewableseast.org.uk
- RegenSW www.regensw.co.uk/
- Renewable Energy Association – www.r-p-a.org.uk

Useful Publications

- HSE Booklet: "Handling and Stacking Bales in Agriculture" (INDG125 rev1) visit: www.hse.gov.uk/pubns
- The DEFRA Code of Good Agricultural Practice for the Protection of Water (1998) www.defra.gov.uk/environ/cogap/watercod.pdf
- Nitrate Vulnerable Zone Regulations www.defra.gov.uk/environment/water/quality/nitrate
- The Sludge Use in Agriculture Regulations
- Cross Compliance Guidance for Soil Management.

www.defra.gov.uk/environment/land/soil/publications.htm#spsguidance