4. Energy crops on brownfield land

20% and 30% compost mixed with site materials have successfully produced topsoil

The EU has set a target of 20% energy from renewable sources by 2020[1]. To contribute towards this an increase in the production of biomass resources for heat, power and transport is required.

The two main perennial energy crop species planted on a significant scale within the UK are miscanthus and willow. Energy crops are mainly cultivated on agricultural land but can be grown on brownfield or marginal land, providing suitable preparation is undertaken. PAS 100 compost can be used to improve the land and support crop growth.

Miscanthus is a woody perennial rhizomatous grass. Once miscanthus is established it can grow to 3.5m and can be harvested annually for at least 15 years[2]. Miscanthus will grow on a wide range of soil types; however higher yields are achieved on moisture retentive soils which warm up quickly in spring, capitalising on the longest possible growing season[3]. Fertiliser demands for the crop are low, with the addition of nutrients and herbicides usually only required in the first year after establishment.

Willow is suited to a wide range of soil types and can be grown on brownfield and reclaimed land providing suitable preparation is undertaken. It is most productive on well aerated soils that retain moisture, with a pH range between 5.5 and 7[4].

High-yielding varieties of willow are grown as short rotation coppice (SRC). The willow is densely planted and can be viable for 30 years before re-planting becomes necessary. Willow is harvested on average every 3 years, whereas other less common crops, such as poplar, ash, alder, hazel, silver birch, sycamore, sweet chestnut, lime and eucalyptus can be harvested on a longer rotation[5].

SRC willow crops require close contact with the surrounding soil and adequate moisture to promote good root development. Failure to obtain adequate moisture at this early establishment stage is the most common reason for plant mortality.

PAS 100 compost can be applied during the preparation of land for energy crop production, and can be applied following cutback and harvesting, but should not be applied during willow establishment[6].

Other energy crops include grasses such as reed canary grass and energy crops for use as transport fuels including cereals (wheat), oilseeds, sugar beet and fodder beet. Some crops may not thrive in poor quality brownfield soil, therefore, it is important to choose the right crop before proceeding.

Establishment of Short Rotation Coppice (SRC) willow on restored soils

The trial at St Ninians, Fife was established to assess the effect of applying PAS 100 compost on a soil recently reinstated after disturbance by opencast mining. The trial was successful in determining that PAS 100 compost can be used for establishing short rotation coppice (SRC) willow[7]. Compost enhances the water retention capability of soils and thereby improves plant establishment.

Establishment of SRC willow on compost treated soil

Willow coppice on reclaimed opencast land in Northumberland

On reclaimed open cast land in Northumberland, the application of food derived compost to SRC willow crops significantly increased yields. Adding food waste to green waste compost increases nitrogen availability, and reduces the tonnage required, with additional advantages of reduced transport and spreading costs[8].

Energy crops on brownfield land

A small scale field trial to assess the potential for using PAS 100 food derived and green composts in energy crop production (miscanthus, reed canary grass and spring oilseed rape) was conducted on a brownfield site in Fife[10].

Assessment of energy crop on brownfield land

The site was re-graded to form a uniform surface and was covered in a mixture of subsoil and topsoil to the depth of 50cm. The entire site was subsoiled (or ripped) to a depth of 30cm using a tined subsoiler prior to application of fertiliser treatments.
Three fertiliser treatments were applied once a year for two years:

- no compost (farm standard fertiliser);
- food derived compost (30 t/ha) + inorganic fertiliser nutrients; and
- green compost (90 t/ha) + inorganic fertiliser nutrients.

Each treatment was applied by hand to the soil surface and cultivated using a power harrow into the top few inches. The trial showed that the reed canary grass was well suited to the site conditions, and grew significantly taller when treated with green or food derived compost. Also soil physical assessments reported less severe compaction and higher quality soil structure where PAS 100 green compost had been applied.

Cost savings and other benefits

The benefits summarised in the Introduction are particularly important for brownfield land that has previously been used for heavy industry or open cast mining. It can take up to ten years to recover from the physical, chemical and environmental damage caused.

The use of PAS 100 compost can help by adding organic matter and decreasing soil bulk density. Increasing the pH and conductivity can lead to increased levels of available plant nutrients, which along with the improvement of a soil's water holding capacity and root zone aeration can help to enhance vegetation establishment.

The application of PAS 100 quality compost for soil improvement or soil manufacturing is cost-effective when compared to traditional materials used for topsoil manufacture and site remediation. The use of compost with existing site materials (coal washings) and recycled aggregate at the Kinglassie former coal washing site in Fife led to cost savings of between £2.46 and £3.30 per tonne when compared to the import of 100% multipurpose topsoil[9], as shown in Table 4-2.

Mix	Cost per tonne			
	Material	Transport	Mixing	Total
100% multipurpose topsoil	£6.00	£1.50	no mixing required	£7.50
20% compost, 80% recycled aggregate	£2.20	£1.50	£0.50	£4.20
20% compost, 48% coal washings material, 32% recycled aggregate	£2.26	£0.75	£1.20	£4.51
30% compost, 42% coal washings material, 28% recycled aggregate	£2.79	£0.75	£1.50	£5.04

Table 4-2: The cost per tonne (£) of different topsoil options for remediation at the Kinglassie site

Application of compost

Manufactured soils must be applied with sufficient depth to allow crop roots to develop normally. Roots must be able to extract adequate water and nutrients, and achieve enough anchorage to resist wind throw. For SRC willow production, compost should be incorporated to the rooting depth of the cuttings, which is 20cm deep, since this may help conserve soil moisture during dry spells[9]. This could be best achieved by ploughing, which inverts the soil and places the compost at the rooting depth. Minimum thickness of topsoil should be confirmed and adjusted depending on the mean summer rainfall and the known particle size and stoniness of the soil forming materials used.

Experience has shown that ratios of 20% and 30% by weight of compost have been mixed with existing site materials successfully to produce topsoil which fulfils the requirements for soil forming materials. These mixes have sufficiently low stone content, a suitable pH and contain appropriate quantities of plant nutrients and organic matter to promote energy crop establishment and growth[9].

Mulch can help prevent weed growth and aid crop establishment, particularly in the first 6 – 10 weeks after application.

Soil Improvement: PAS 100 compost can be used on brownfield sites to improve soil so that it is suitable for energy crop production. Trials have found that optimum crop yields were achieved after applications of 500 or 750t/ha[11]. Application levels above this had no further positive effect on crop growth.

Establishing SRC willow on the former Bickershaw Colliery

In 2010, PAS 100 compost was applied to land on the former Bickershaw colliery for SRC willow production. The trial showed that when used to improve native substrate materials, compost leads to the successful establishment and growth of these energy crops[12].

PAS 100 compost was incorporated into the existing colliery spoil to a depth of 300mm. The addition of compost at an equivalent rate of 500 t/ha greatly enhanced survival of individual cuttings and enhanced fresh biomass yield.

Established willow, Bickershaw

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