

The effects of rhizome size, planting density and plastic mulch on the growth and dry matter yield of miscanthus over three seasons

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Introduction Miscanthus (*Miscanthus x giganteus*), a C4 perennial grass from the Far East, is being increasingly widely grown in the British Isles as a biomass crop with an annual harvest. Following establishment by planting rhizome sections into cultivated ground it can take four to five years for the crop to reach its maximum level of productivity. An experiment is in progress in Northern Ireland into the use of degradable plastic mulch to accelerate the development of the crop, and its interaction with rhizome size and density at planting. The first three years of the study are described in this paper.

Materials and methods Rhizomes from miscanthus planted in 2003 were harvested in April 2007 and stored at 3°C. The rhizome pieces were sorted into three size fractions which averaged weights of 26g, 74g and 204g. Experimental sites at Hillsborough and Loughgall were prepared by conventional cultivation and rhizomes planted by hand in early May in shallow furrows in plots 10m x 7.5m at densities equivalent to 450 kg, 1350 kg and 4050 kg per hectare for each size fraction. The rhizomes were covered with soil to a depth of about 7.5cm and the herbicide pendimethalin applied at 2.5 litres/ha. The four randomised blocks at each site comprised main plots with and without bio-degradable plastic mulch, applied shortly after planting with a single row mulch layer supplied by SAMCO Agricultural Manufacturing Ltd, and nine size x density sub-plots. Regular counts were taken of the number of shoots, and of shoot height, over the 2007, 2008 and 2009 seasons. DM yield above ground was assessed by sampling in the late autumn and again in the spring before the plots were harvested. Data was statistically analysed as a split-split-plot randomised block design.

Results and discussion The increase in the number of shoots as the rhizome size was reduced from 204 g to 26 g reported by Easson *et al* (2008) for the first year of this study was maintained into the 2nd and 3rd years (Table 1), along with an overall doubling of the number of shoots in the 3rd season compared with the first season. The increased number of shoots resulted in significantly higher DM yields with decreasing rhizome size at planting at all harvest dates.

Table 1 Main treatment effects of rhizome size, planting density and plastic mulch treatment at planting on the growth and yield of miscanthus in the first three seasons (mean of two sites)

		Shoot numbers per hectare ('000s)			Crop height (cm)		DM yield (t/ha)		
		Oct '07	Oct '08	Oct '09	Oct '08	Oct '09	Mar '08	Nov '08	Mar '09
Rhizome size	26g	140	222	309	187	234	0.81	9.28	6.07
	74g	99	166	234	184	228	0.65	7.79	5.27
	204g	69	99	130	182	221	0.44	5.03	2.95
l.s.d. (P=0.05, 94 df)		12.6	14.8	22.5	3.3	9.7	0.126	1.636	1.215
Density kg/ha	450	39	63	90	160	201	0.19	3.59	2.09
	1350	80	151	215	179	227	0.43	6.51	3.94
	4050	189	273	368	214	256	1.27	12.00	8.25
l.s.d. (P=0.05, 94 df)		12.6	14.8	22.5	3.3	9.7	0.126	1.636	1.215
Mulch	without	67	134	196	180	227	0.47	5.98	3.97
	with	131	191	253	189	229	0.79	8.75	5.55
l.s.d. (P=0.05, 6 df)		12.9	23.2	35.0	5.7	25.6	0.108	1.571	1.422
Mean		103	162	224	185	228	0.63	7.37	4.76

The number of shoots also increased significantly at higher planting densities so that the number of shoots and the DM yield almost doubled with each threefold increase in planting rate, the ratio remaining similar into the 3rd season. Crop height increased significantly with increased density. The use of mulch increased the number of shoots in the first season by 96%, and this effect carried on into the 2nd and 3rd seasons in which shoot numbers were higher by 48% and 38% respectively. Crop height was significantly increased in the 2nd season, but not the 3rd. Crop yield increased by 70%, 46% and 40% at the March and November 2008 and March 2009 sampling dates respectively. Interaction effects between the use of mulch, rhizome size and planting density were relatively small. The highest yields were therefore from the 24g rhizome size planted at high density with the use of plastic mulch with yields of 17.8 tDM/ha and 10.7 tDM/ha in November 2008 and March 2009 respectively. The results from these harvest dates reveal over-winter losses from leaf fall and the loss of upper internodes of 30% to 40%. Under Northern Ireland conditions little drying of the crop took place over winter and at the March harvest date in both 2008 and 2009 the stem was about 50% DM.

Conclusions The use of degradable plastic mulch at planting accelerated the early development of miscanthus, with the benefits continuing into subsequent years. Within the ranges of weights used in this experiment dividing rhizomes into smaller sections for planting achieved higher shoot numbers and yields over the first two seasons.

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Reference

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