HGCA

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FURTHER STUDIES ON COMPOSTING FLOUR MILLING CO-PRODUCTS

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by

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ABBREVIATIONS

cm	centimetre
DM	Dry matter
g	gram
ha	hectare
kg	kilogram
LA	Levington Agriculture Limited
l	litre
m	metre
mm	millimetre
mg	milligram
ml	millilitre
microS/cm	micro Siemens per centimetre

OBJECTIVE

To assess bran, wheatfeed, other organic materials and waste water by analysis, composting and trials for use as horticultural products.

This study continues on from the work carried out as reported in HGCA Report No. 144.

SUMMARY

Milling by-products, bran, wheatfeed and friction bran, were composted with water, waste wash water from starch production and carbon-rich waste products. The composted materials were tested by laboratory analysis. Materials produced in the previous year were tested as a lawn fertilizer and as a growing medium for tomatoes.

During composting mass was lost in the form of carbon dioxide, and the dry matter was on average reduced to 40% of that originally present. The bran and wheatfeed, composted without the addition of other carbon sources, produced nutrient-rich materials. With wheatfeed added to paper waste, the compost produced may be suitable for the growth of tomatoes.

Friction bran composted, but having less protein to start with, gave a material low in available nitrogen but still relatively high in potassium. The friction bran was difficult to wet up initially and required a greater addition of water for composting to commence than bran or wheatfeed. However, once the material had broken down the material was therefore much wetter than the others and difficult to handle.

Bran mixed with shredded banknotes composted well but a greater proportion of banknotes to bran would be needed to reduce the conductivity and make an acceptable growing medium.

The waste wash water had very little nutrient value and no real differences in composts made with either wash water or with mains water could be found.

An unreplicated trial of composted wheatfeed on lawn turf containing moss indicated that grass growth and colour were promoted and that moss was smothered and thereby reduced in visibility.

Tomatoes were grown in pots containing composted bran and wheatfeed mixed with peat or woodfibre. The plants grew very well and showed that additional lime and inorganic fertilizers were unnecessary, and that liquid feeding could be delayed. The growing media contained 20% by volume of the composts with the bran compost releasing more nutrient than the wheatfeed. However, the wheatfeed mixes tended to be more balanced nutritionally and gave tomatoes of better quality.

MATERIALS & METHODS

Bran and wheatfeed materials were obtained from Rank Hovis Ltd, Felixtowe, the latter being a mixture of bran and fibre offals. Pearlings (also known as friction bran) was obtained from E Timm & Sons Ltd. Paper waste was obtained from Bridgewater Paper Company Ltd, and shredded bank notes from the Bank of England. Waste wash water was obtained from ABR Foods. We wish to acknowledge the support from these organisations for the provision of these materials.

The feedstocks were analysed and mixtures for composting calculated accordingly. Either the waste wash water or mains water was used to wet up the dry products before they were placed in composting containers. The composts were analysed during and after composting.

The composted products from the previous study were used in growing trials either as a lawn fertilizer or as a component of growing media for tomatoes.

RESULTS

1. Analysis of feedstocks

The composition of the feedstocks was analysed as shown in Table 1. The friction bran was much lower in nutrient content than bran or wheatfeed and also therefore had a greater Carbon to Nitrogen (C:N) ratio. This was a result of the differences in methods of milling. The banknotes and paper waste were very low in nutrients and had much higher C:N ratios with the paper waste having a greater content of non-organic materials. The wash water was a very dilute solution of nutrients.

2. Composting

The following compost mixes were prepared:

Bran + water
Bran + wash water

Wheatfeed + water
Wheatfeed + paper waste + water

Friction bran + water
Friction bran + wash water

Bran + banknotes + water

The amounts of the feedstocks used for composting for each mix is given in Table 2. The friction bran was found to absorb much greater amounts of water than the other materials and hence additional water was added as shown.

TABLE 1 ANALYSIS OF FEEDSTOCKS

	Bulk Density g/l	Moisture % in fresh	Organic matter % of dm	Organic carbon % of dm	% N in dm	% P in dm	% K in dm	C:N ratio
Friction bran	167	17	97	43	0.9	0.15	0.88	48
Wheatfeed	359	13	95	40	2.6	0.9	1.20	15
Bran	213	11	94	38	2.3	0.9	1.83	16.5
Banknotes	288	3	96	41	0.2	0.03	0.27	205
Paper waste	437	45.5	50	25	0.4	0.1	0.07	62

Wash water	mg/litre of sample
N	40
P	72
K	46
Mg	10

TABLE 2 FEEDSTOCK MIXES

The moisture contents of the materials are given in brackets. All of the mixes resulted in a reduction in mass to an average of 40% of dry matter of the original.

Bran + water Started 21/4/97

35 kg bran (12.7%) + 41 litres water

Bran + wash water Started 21/4/97

35 kg bran (12.7%) + 41 litres water

Wheatfeed (WF) + water Started 21/3/97

45 kg WF (11.7%) + 54 litres water

Wheatfeed (WF) + paper waste + water Started 20/3/97

12.5 kg WF (11.7%) + 60.5 kg paper (45.5%) + 37 litres water

Friction bran (FB) + water Started 21/3/97

20 kg FB (17.5%) + 21 litres water + 25 litres water 9/4/97

Friction bran (FB) + wash water Started 7/4/97

20 kg FB (17.5%) + 21 litres water + 23 litres wash water + 2 litres tap water 21/4/97

Bran + banknotes + water Started 19/5/97

18 kg bran (12.7%) + 18 kg banknotes (3%)+ 45 litres water

Table 3 Analysis of products

		Fresh bulk density g/l	Moisture %	pH	Conductivity microS	Total N %	Total P %	Total K %	Organic carbon %	C:N ratio	Water extractables: NH4-N mg/l	NO3-N mg/l	P mg/l	K mg/l	Mg mg/l
Wheatfeed 1996 compost tested 1997		605	75	8.9	4200	2.28	1.49	2.96	59	17	1320	4	1740	4140	5
Bran + water	1 month	436	72	8.2	3400						168	3	900	3864	26
	3 months	489	73	8.9	2800	2.50	2.00	3.60	38	15	960	6	1152	3408	23
Bran + wash water	1 month	413	66	7.2	4000						1920	0	1080	2640	198
	3 months	483	73	8.9	3700	2.30	1.70	3.10	38	17	1500	3	984	3198	9
Wheatfeed + water	1 month	584	67	5.0	3300						1560	3	1920	2790	606
	3 months	636	69	7.4	4800	3.30	1.80	2.90	37	11	2340	3	1200	4584	4
Wheatfeed + paper + water	1 month	635	62	8.0	1160						510	3	29	594	56
	3 months	735	65	7.1	840	0.70	0.42	0.60	22	32	60	102	300	666	79
Friction bran + water	1 month	487	80	8.3	490						6	6	96	2520	12
	3 months	412	77	8.7	900	1.90	0.46	3.00	38	20	30	3	168	1554	23
Friction bran + wash water	1 month	695	79	7.8	1700						48	4	11	2676	19
	3 months	579	77	8.5	1650	1.90	0.44	2.75	41	22	24	2	132	1932	19
Bran + banknotes	1 month	378	57	6.4	1200						276	0	300	1104	110
	3 months	487	71	8.2	1600	2.20	1.00	1.60	38	17	360	1	300	1698	45
Tomato trial mixes															
Peat-based Grobag		397	60.5	5.5	510						138	126	60	218	70
Bran + peat		282	53	6.6	870						210	5	1020	1218	10
Wheatfeed + peat		294	69	7.2	560						258	4	540	336	1
Wheatfeed + Sylvafibre		397	57.5	8.8	750						276	4	390	552	4

3. **Analysis of products**

The wheatfeed material composted in 1996 was analysed in 1997 prior to its use in the growing trials. The data is given in Table 3 and the total nutrient contents of N : P_2O_5 : K_2O were 2.3 : 3.4 : 3.6.

The composts produced during this study were analysed after approximately 1 and 3 months after commencement. The results are also shown in Table 3. The composted bran and wheatfeed, wetted with water or wash water, were materials with high nutrient availability, conductivity and pH after 3 months. The addition of paper waste to the wheatfeed resulted in a material which could be tested for use as a growing medium for transplanted tomatoes.

The friction bran, with its initial low protein content, resulted in composts with low available nitrogen levels. However, the potassium contents of the composts were still high resulting in conductivities which were raised.

The banknotes composted well with the bran but a greater quantity of banknotes may be needed if the conductivity is to be lowered sufficiently for use as a plant growth medium. Further dilution of this composted material would be required before use.

4. Lawn trial

The wheatfeed compost from 1996 was used as a lawn topdressing in an unreplicated trial to assess improvements in the grass growth and control of moss. The compost was air dried and sieved to produce either fine (less than 3 mm) or coarse (less than 6 mm) materials.

The fine material was spread evenly at three rates, the coarse material at two rates, and other plots were left as untreated controls. At the lowest rate, the fine material did not cover all of the moss present which the middle rate of 500 g/m^2 did. At the highest rate the grass tended to be smothered but did grow through well. The coarse material was less effective at covering the moss than the fine material. The moss control was a smothering effect rather than moss kill. Moss cover in the untreated plots declined from spring into summer, which is a normal effect as ground conditions become drier, and moss cover could not be assessed at the end of July due to these effects of dry weather.

The results are shown in Table 4, and show that the grass colour and vigour were improved by the addition of the compost materials with responses to the increases in rates of application. Visible moss cover was also reduced by the addition of the materials with the fine material being more effective than the coarse, especially at the highest rate of application.

The results indicate that it would be worthwhile to use the composted wheatfeed as a grass topdressing in comparison with standard products in fully replicated trials.

Table 4 Lawn trial assessments

Lawn trial assessment end April 1997

			grass colour	grass vigour	moss cover as % of original	Moss cover effect compared with control
1	Untreated control		4.4	4.7	59	100
2	250 g/m^2	fine	6	6	47	80
3	500 g/m^2	fine	7	6	20	34
4	1000 g/m^2	fine	8	8	4	7
5	250 g/m^2	coarse	7	7	13	22
6	500 g/m^2	coarse	8	7	33	56

Lawn trial assessment end May 1997

			grass colour	grass vigour	moss cover as % of original	Moss cover effect compared with control
1	Untreated control		6.4	6.4	25	100
2	250 g/m^2	fine	6.5	7	20	80
3	500 g/m^2	fine	7	7	9	36
4	1000 g/m^2	fine	8.5	9	4	16
5	250 g/m^2	coarse	7	8	13	52
6	500 g/m^2	coarse	8	8	17	68

Lawn trial assessment end July 1997

			grass colour	grass vigour
1	Untreated control		4.7	4.8
2	250 g/m^2	fine	5.5	5
3	500 g/m^2	fine	5	4
4	1000 g/m^2	fine	6	7
5	250 g/m^2	coarse	5	5
6	500 g/m^2	coarse	6	5

5. **Tomato trial**

The bran and wheatfeed composts made in 1996 were used as a source of nutrients for tomatoes growing in pots but simulating growing bag conditions. Four 10" diameter (7 litre) pots of each of the following mixes were filled with the composts and established tomato plants transplanted on 29/4/97. Feeds were applied to two pots of each compost and two were left unfed to starve out. Plant heights were measured, colour and vigour assessed and ripe fruit weighed. At the end of July the remaining green fruit was weighed and the plant stem fresh weights recorded.

The treatments consisted of:

1	Grobag (peat-based)	unfed
2	Bran compost 20% Peat 80%	unfed
3	Wheatfeed compost 20% Peat 80%	unfed
4	Wheatfeed compost 20% Sylvafibre 80%	unfed
5	Grobag (peat-based)	fed
6	Bran compost 20% Peat 80%	fed
7	Wheatfeed compost 20% Peat 80%	fed
8	Wheatfeed compost 20% Sylvafibre 80%	fed

Sylvafibre is a commercially available substrate made from wood fibre. No other fertilizers or lime, apart from the liquid treatments, were given.

The mixes were analysed as shown in Table 3. The nitrogen contents were good, although predominantly in the ammonium form rather than 50:50 ammonium:nitrate. The bran mix with peat had very much higher potassium levels than the other mixes. The magnesium contents of the mixes were low compared with the Grobag. The pH particularly of the mix with Sylvafibre was high. The results of assessments are given in Table 5, and yields in Table 6 and shown in graph 1.

By the end of July, the peat based Grobag had run out of nutrients as shown by the poor colour and vigour scores, and the yield potential for August was poor with only a small amount of green fruit. However, feeding of the peat-based Grobag as recommended resulted in good growth and yields.

The bran and wheatfeed mixes, unfed, resulted in good plant colour and vigour scores which declined more slowly than those grown in the Grobag without feeding, indicating an additional slow release of nutrients. The bran mix gave stronger plants than the wheatfeed mix with peat, however, the wheatfeed + peat gave the better earlier yields but less green fruit. The Sylvafibre mix resulted in poorer yields as the woodfibre tends to utilise some of the available nitrogen as it continues to slowly decompose.

With feeding the bran + peat mix may have given excessive nutrients to the plants and so retarded yields. With this mix and feeding, blossom end rot occurred indicating nutrient imbalances and stress. The wheatfeed mixes gave very good yields.

The results indicate that both lime and inorganic fertilizers can be substituted with the composted materials which also provide 20% of the bulk volume and a saving in peat use. Mixed with Sylvafibre, good results were also found but earlier liquid feeding may be necessary, although still less than for a peat-based Grobag.

Table 5 Tomato trial assessments

Tomato trial - plant heights

		Heights cm				final stem
		13/5	27/5	10/6	26/6	weight g
1	Peat-based Grobag unfed	42	71	102	110	307
2	Bran + peat unfed	39	67	99	114	695
3	Wheatfeed + peat unfed	40	68	99	105	408
4	Wheatfeed + Sylvafibre unfed	38	67	95	110	566
5	Peat-based Grobag fed	40	69	89	108	1026
6	Bran + peat fed	37	64	96	120	1095
7	Wheatfeed + peat fed	41	74	104	116	1209
8	Wheatfeed + Sylvafibre fed	39	69	99	117	974

Tomato trial - plant colour and vigour

		Colour			Vigour		
		10/6	26/6	14/7	10/6	26/6	14/7
1	Peat-based Grobag unfed	1	1	1	3.5	2	2
2	Bran + peat unfed	4.5	4.5	3.5	3.5	4	4
3	Wheatfeed + peat unfed	4.5	3	2	3.5	3.5	3
4	Wheatfeed + Sylvafibre unfed	3	3	2	4.5	4	3.5
5	Peat-based Grobag fed	2.5	4	4	4.5	4.5	4.5
6	Bran + peat fed	4.5	5	4.5	4.5	5	4.5
7	Wheatfeed + peat fed	4	5	4.5	5	5	5
8	Wheatfeed + Sylvafibre fed	4.5	4	3	5	5	4

Table 6 Tomato yields

Tomato fruit yields per plant (g)

	26/6/97	2/7/97	9/7/97	14/7/97	17/7/97	21/7/97	25/7/97	30/7/97	Green fruit	Total
1 Control no feed	0	0	200	435	553	159	43	129	144	1662
2 Bran + Peat no feed	0	51	303	467	209	390	333	320	1204	3275
3 Wheatfeed + Peat no feed	0	47	143	526	854	645	365	232	486	3297
4 Wheatfeed + Sylvafibre no feed	0	41	198	211	387	434	392	485	515	2661
5 Control + feed	0	0	102	232	311	328	479	361	1514	3325
6 Bran + Peat + feed	49	77	404	294	233	225	256	136	1166	2838
7 Wheatfeed + Peat + feed	0	38	280	387	423	251	385	398	1784	3945
8 Wheatfeed + Sylvafibre + feed	13	0	114	268	415	205	386	363	1568	3331

Graph 1 Tomato yields