MAFF FUNDED R&D PROJECT NF303

THE INDUSTRIAL POTENTIAL OF FIBRE FROM UK – GROWN CROPS

EXECUTIVE SUMMARY

1) The overall objective was to assess the potential feasibility for industrial use of fibre from twelve crops

2) suitable for growing in the UK, by a) assessing the costs and feasibility of growing, harvesting and storing the crops and extracting fibre, b) investigating the properties and processability of the fibre for pulp and paper, wood-based panels and textiles and the properties of the prototype products made, c) assessing the economic competitiveness of fibre crops against other farm crops and of the fibre against competing materials in industrial markets, and d) investigating the industrial acceptability of the fibre and prototype products.

3) The research was carried out by ADAS, the Agricultural Research Institute of Northern Ireland, the BioComposites Centre University of Wales, Silsoe Research Institute and the University of Leeds School of Textile Industries. Silsoe Research Institute coordinated the project.

4) It proved possible to grow a range of crops in Southern England for fibre but not all of the crops are currently suitable for commercial field production. Growing crops elsewhere in UK was not studied. This means that fibre and product evaluations were done on one sample in most cases, and their conclusions should be qualified accordingly.

5) Harvesting systems that are technically feasible have been identified and specified for each of the fibre crops and for each form of the product from that crop. For some crops, special machinery is needed. Fibre extraction by decortication is feasible if the crops are suitably retted though wrapping led to low work rates for hemp. Chopping to produce particles is feasible provided crops are not retted. The dryness of the crops for storage free from moulds has been measured. Drying is a problem in the production of winter-harvested crops and for crops that need retting. Without drying they deteriorate.

6) In textile applications, variations in raw material quality and high shive content severely limit the acceptability of the fibre to potential users. Access to high quality markets is dictated by quality and price. Microbial activity in dust from most stem fibres may constrain use of the fibres in a commercial environment. If these limitations can be overcome flax and hemp fibres, which have the greatest industrial potential, would be more readily acceptable to manufacturers of technical textiles, e.g. in the geotextile, horticultural and automotive industries. Flax can be blended and processed as an apparel fibre but appears to offer no specific enhancement of the technical performance of cotton or wool. This does not preclude its use where an economic advantage is apparent or in non-woven or technical textiles. The sample of hemp investigated was not suitable for processing by the routes tried was unsuitable as a mainstream apparel fibre. Nettle fibre is difficult to extract but useable. Hollyhock and marshmallow fibre were not suitable for processing down any of the routes tried.

7) The quality of fibre produced is almost entirely a reflection of the management of the crop and the methods adopted for harvesting, and retting the straw and extracting the fibre. When grown, harvested and water retted as a fibre crop in NI, the quality of flax

fibre after scutching is equivalent to that of high quality Belgian flax while fibre from stand retted and dew retted flax is similar in quality to Russian dew retted fibre.

8) None of the crops was suitable for mechanical pulping because the fibres became too short during processing. Although semi-chemical pulping of some crops was successful, the industry is geared to waste paper so uptake is unlikely in the foreseeable future. Chemical pulp from short fibre materials - miscanthus, reed canary grass and wheat straw - have properties acceptable to the paper industry but owing to investment costs and the scale of raw material supply needed, uptake is only likely if smaller-scale pulping processes are developed. Long fibre materials – flax, linseed and hemp – are suitable for speciality pulps but separated fibre is preferable to whole stems to improve pulp yield and reduce chemical use.

9) For particleboards, coppice poplar was the most promising. Particle size and geometry can improve board performance. All the materials studied could be used when blended with wood for medium density fibreboard. Coppice poplar, miscanthus, rape and reed canary grass could be used at up to 50% substitution.

10) The rational financial model constructed brings together the opportunities and constraints of agriculture and fibre-using industries so that research priorities and commercial investment decisions can be made with the highest confidence within the limits of data available. Scenarios were investigated comprising of a variety of levels of the technical factors and support payments influencing the production of fibres from current good practice to maximum feasible potential. From an analysis of the minimum price at which the fibre crops could be produced under existing support policies and the maximum price industry would pay for them, it appears that by-products - wheat, rape and linseed straws - are potentially profitable for short fibre biocomposites. Flax and hemp are potentially profitable for textiles and chemical pulping.

11) Proposals are presented for further research needed to improve the industrial potential of the most promising crops.

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