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COMPARISON OF PROPERTIES OF FLAX LINEN VARIETIES GROWN IN NORMANDY FRANCE VERSUS MANITOBA CANADA

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Jennifer Bell[1(*)], Shuhan Liu[2], Diogenes Vedoy[3], Mercedes Alcock[4], Franck Callebert[5], Lorne Grieger[6], Eric Liu[7], Frank Wheeler[8], Shawna DuCharme[9], Sean McKay[10] , and Lin-P'ing Choo-Smith[11]
[1-4,8-11]FibreCITY, Composites Innovation Centre, Winnipeg, Manitoba, Canada
[5]Groupe Depestele, Bourguebus, France
[6]Prairie Agricultural Machinery Institute, Portage La Prairie, Manitoba, Canada
[7]Manitoba Agriculture, Winnipeg, Manitoba, Canada
[(*)]*Email:* jbell@compositesinnovation.ca

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ABSTRACT

The properties of two linen flax varieties (Alizee and Aretha) traditionally grown in the Normandy region of France were compared with the properties of the same varieties grown in two locations (Melita and Portage La Prairie) in Manitoba, Canada. Investigations on the mechanical and chemical properties of the fibres were conducted to determine the level of retting of the straw, which affects the effectiveness of scutching the straw to produce long line fibres. Optimal retting is currently a limiting factor in cost-effective processing of flax straw to produce high quality long line fibre for industrial uses. This study demonstrated that flax grown in some regions of Manitoba was similar to that grown in the Normandy region. These finding illustrate the potential for Canada to yield overall good quality fibre with appropriate fineness and homogeneity.

INTRODUCTION

Linen flax has been successfully grown in regions of Europe such as Normandy, France to produce long line fibres used in textile and high value industrial applications like composite materials. It is unclear how flax grown in the shorter and drier growing seasons in Canada would compare to those grown in the longer seasons and temperate climates of France that are conducive for optimal field retting. The rationale of this study was to determine whether flax fibre varieties that grow well in Europe would yield sufficiently good quality straw and scutched fibre when grown in Canada with potential to serve the North American market.

Two flax varieties (Alizee and Aretha) were grown in Normandy, France and in two locations in Manitoba, Canada, namely Portage La Prairie (Portage) and Melita in the 2015 growing season. Flax straw from the three locations was scutched to separate the bast fibres from the inner shive/tow material using the straw processing lines at Groupe Depestele (Bourguebus, France). The scutched fibres were investigated at the FibreCITY facility at the Composites Innovation Centre (Winnipeg, Manitoba). High resolution scanning electron microscopy (SEM) was used to observe the fibre surface topology, level of cleanliness and the degree of separation of fibres into technical bundles. Powder x-ray diffractometry (XRD) radial profiles were extracted to calculate the cellulose crystallinity on triplicate measurements from 5 fibres of each sample type. In addition, single fibre tensile testing with rotational diameter analysis was completed on 100 single fibres to determine the strength of each sample. Attenuated total reflection Fourier transform infrared (FTIR) spectroscopy was used to examine the bulk chemical properties of the fibres. Wet laboratory chemical analyses were conducted by an external third-party.

RESULTS AND CONCLUSIONS

The ease of scutching the straw to yield fibres was evaluated and it was determined that the flax grown in Portage was not adequately retted which resulted in poor scutching capacity compared to the flax grown in Melita. Processing yields (tons/hour) of Portage straw were half of that obtained from the Normandy and Melita material. When investigated further with SEM, the adequately retted flax straw produced fibres that appeared cleaner and separated better into technical fibre bundles as compared to the poorly retted material (Fig. 1). XRD analyses showed that Normandy and Melita fibres had a higher crystallinity index than Portage fibres (Fig. 2). As the crystallinity index is a ratio of the crystalline and amorphous cellulose content, better retting results in a lower amorphous cellulose component and an overall higher crystallinity index. The strength of the fibres followed similar trends for both varieties. The Normandy material was observed to have higher tensile strength (statistically significant at $p<0.05$; ANOVA and Tukey-Kramer HSD tests) than the Melita and Portage fibres, with the Melita material having higher tensile strength than Portage fibre (Fig. 2). Chemical analyses with wet chemistry and FTIR spectroscopy revealed that surprisingly the presence of pectin was most apparent in the Normandy samples. The overall results of Melita flax fibres provide encouraging evidence of the potential of growing traditional European flax varieties in Canada to produce long line fibre for the North American market. Follow up studies are underway to optimize retting practices for varieties grown in Canada.

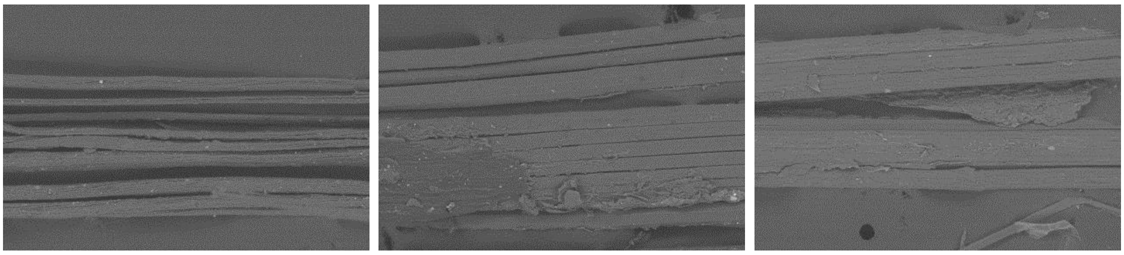

Fig. 1: SEM images (200X magnification) of flax fibres of Aretha Normandy (left), Aretha Melita (middle) and Aretha Portage (right).

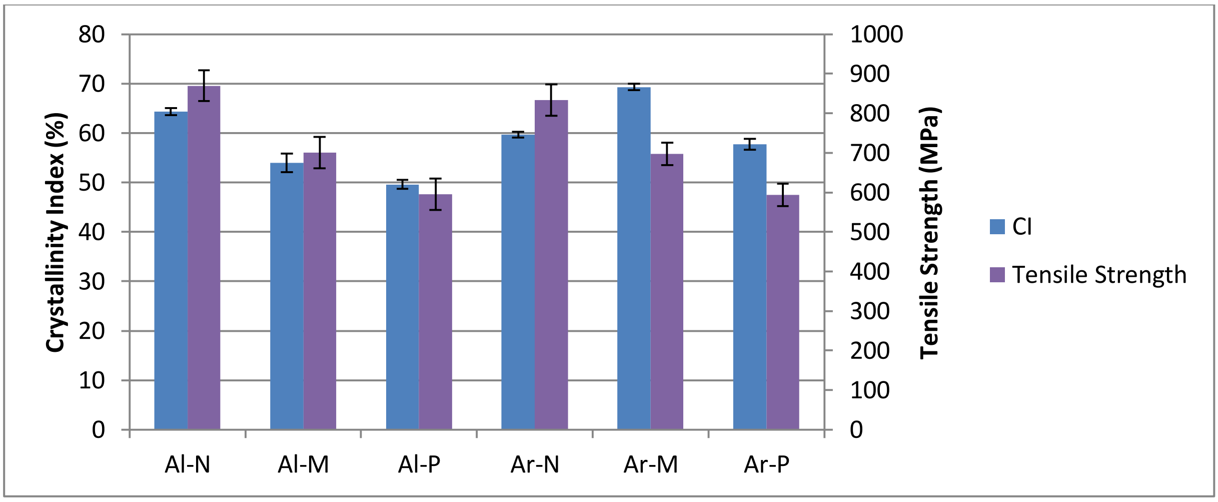

Fig. 2: Bar graph of mean crystallinity index (CI) values (%) for the Alizee (Al) and Aretha (Ar) fibres of flax varieties grown in Normandy (N), Melita (M) and Portage (P). Error bars denote standard error.

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