“Prospect of Hemp Utilisation in the European Textile Industry”

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Historically, hemp is one of the oldest plants grown for its fibre, and used as a basic raw material for the production of rope, canvas and clothing.
In Europe, hemp cultivation reached its maximum between the 16th and 18th centuries, while in Italy, during the first half of the 19th century, hemp cultivated areas had reached 100.000 hectares. This placed Italy in second place to Russia as a hemp producer insofar as quantity, but first for quality.
The decline arrived after the II World War for several reasons: high labour costs compared to the developing countries, the advent of synthetic fibres, drug policies and the large scale production of cotton.
In fact, among natural fibres, cotton dominates the textile industry, but due to water consumption and pesticide usage as well as climactic limitations for its cultivation it is unlikely that cotton production will be able to satisfy future demands for natural fibres, especially if we consider the current excalating interest in natural fibres, due to their positive effects on agriculture, the environment and the economy. As a consequence it is expected that other natural fibres will easily fill this gap in supply.
Moreover, developed countries have viewed fibre crops as an economic solution to the overproduction of food on their land, rather than continuing to deploy unproductive “set aside” land.
That is why, during the last decade, there has been a revived interest in hemp as a renewable resource.
It has been intensively promoted by different institutions in Europe and has become an economically interesting crop thanks to European Community subsidies, resulting in a vast increase of cultivated areas.
In Europe, cultivated areas have risen from 2762 Ha. in 1989 to a peak of 41682 Ha. in 1998 (table 1).
As matter of fact, following the 1998 peak there was a sharp decrease due to reduced subsidies and the introduction of new stricter European policy regulations for the allocation of subsidies related to cultivated surfaces – minimum threshold in straw yield – as well as the first processing step, this was in order to avoid speculation as happened in Spain.
Consequently, the widespread use of hemp fibres for technical applications, as for example in the automotive or paper industry, did not produce a similar increase in cultivated areas; the main reason being the discrepancy between production costs and the performance of the final product.
This discrepancy is no longer compensated for, by EC financial support and market competition in the world for raw materials used for technical applications is mainly based on price rather than on quality.
Therefore, fibre production in countries having high labour costs, such as in Europe, can only be profitable if it is aimed at a market producing high added value products such as textiles or for other specific technical uses.

During the last few years several European research projects have been carried out, and others have been recently implemented, in order to develop new production methods and establish new technical applications which are essentially indispensable.
If hemp is to play an important role in the textile sector again, it needs to overcome a series of technical constraints, involving the entire sequence of production and utilisation. As a medium or long-term goal this could involve great economical and technical effort but if significant savings in hemp retting and preparation costs can be achieved then larger scale textile markets can be exploited.
On the other hand should it be established that the costs of preparing hemp fibre cannot be significantly reduced, then the use of hemp will remain as an exclusive luxury apparel fibre with only a small niche market in Europe.
At present the traditional processing of hemp is still at the same technological level to that of 50 years ago and consequently only viable for the low labour cost countries. However, considering all these efforts, only a negligible amount of total fibre production, that is long fibre, has been aimed at the textile industry.
Major production of long fibre hemp is limited to China and to a much lesser extent to Eastern European Countries such as Romania, Hungary and Bulgary.
These countries use a traditional processing chain comprising many labour intensive steps starting from harvesting, water retting and scutching.
The final product consists of water retted and scutched hemp bundles containing lengths of between 2 and 3 meters; in China, short fibre slivers are generally obtained by chemical retting and breaking.
The quality of these fibres only allows production of medium quality textiles for use in household products rather than clothing, whereas demand from the fashion textile market could pay for the main part of the costs of the whole production chain of long fibre production.
Meanwhile, as a short-term strategy it should be possible to process hemp fibres in factories using existing flax machines without involving extensive new development and financing.
With this in mind, some trials were made to adapt hemp plant to the flax processing infrastructures, particularly to the scutching machine arrangements.
Today, only a very small quantity of long fibre is produced in Europe, above all in France, by intensive sowing that means 100-120 Kg of seeds per Ha.
In the last few years the Canapa Italia Consortium carried out similar attempts in Italy even if there are no industrial fibre decortication facilities.
When the hemp stems are 1 to 1.2 m tall, they are sprayed with desiccants, generally glyphosate, to stop their growth. From then on the stems undergo the same initial flax processing methods: pulling, dew retting, drying, storing and scutching. Then the scutched material can be sent to a spinning factory to be converted into yarn.
The advantages of this procedure are clear: plant height is tailored to be processed on the same equipment used for flax; moreover, due to fast growth it is possible to obtain more than one hemp harvest per year, at least at certain latitudes. The poor lignification, due to plant immaturity, makes the dew retting process easier even if still inferior in comparison to flax.

However, among the disadvantages are: the high cultivation costs, low straw yield - (between 30 and 50% of normal hemp), the use of chemicals, the poor quality of the fibre and its unevenness due to plant immaturity, as well as the dew retting process.
All these disadvantages greatly affect the final cost of the product, both directly during cultivation and early processing, and indirectly during spinning and weaving, for poor processing performance and yields.
By comparison the price of hemp wet spun yarn quoted between 30 and 50 % higher than corresponding flax, another high cost intensive natural fibre.
This means that production is economically profitable only during particular fashion periods.
Another strategy to adapt hemp plant to flax processing equipment could be the following:as hemp can normally be grown to a height of two to four metres our suggestion is to cut stems in sections of one metre length during harvesting.
The production capability of the entire plant could be exploited by this tecnique as well as its yield per Ha with reduced cultivation costs.
By stem subdivision it could also be possible to optimize the retting process (by using both dew retting and water retting) tailoring it to the different plant sections; in fact the constituent plant composition is different along the stem. The retting procedure is of crucial importance to the processability of the long bast fibres (flax, hemp, kenaf). This has an important bearing on the final quality of the fibre: a good retting procedure allows an easy decortication and a good scutching yield preserving fibre tenacity .
Moreover the different sections of the stem could be aimed at different end uses depending on their different fibre characteristics and content.
In this way all the co-products of the plant (e.g. fibre, core, seed, and oil) can make their contribution to achieve a good global profitable level.
We therefore saw as a primary need the development of an harvesting machine able to render the raw material manageble and processable from field to factory.
As far as I am aware, some studies have already been carried out and some prototypes developed, tested and patented, and it would be very interesting to verify their characteristics and potential.
Should the development of a harvesting machine be achieved I think it would be possible to supply long fibre hemp at prices comparable to those of flax.
This is the first condition necessary for a wider utilisation of hemp fibre in the european textile industry together with a guaranteed supply of sufficient quantities of suitable raw materials.
With regard to fibre quality, dominant parameters in textile applications are fibre strength, fineness and refinability. Homogeneity of a batch is another very important aspect.
Most of all, hemp suffers from coarseness of fibre. Hemp fibres and yarns currently on the market do not fulfill the requirements of the textile industry.In order to introduce hemp into the high quality clothing sector it is necessary to have a degree of fineness that allows the spinning of yarns between Nm 20 and Nm 40. Also, the fibre extraction process has a major impact on final product quality. The finer the fibre the wider its application in clothing and industrial

textiles. It is clear that varieties of hemp having fibres with smaller diameter must be developed.

As previously mentioned a very important point is the retting process. The most common process is dew retting on the fields. The influence of uncontrollable weather conditions (humidity, sun) on the process is extremely high; some years part of the crop is lost because over-retting occurs. In under-retted samples the pectin content is too high for good separation of bast fibres and shives which causes substantial problems during further processing (decortication, cleaning and combing, fibre separation). The simplicity of the dew retting process and relatively low investment costs have resulted in its continuation as a major technology.

Water retting is a more readily controllable process and much more efficient for hemp stalks than dew retting. Recent studies have demonstrated the feasibility of re-cycling retting water as fertilizer. The additional costs of the process could be compensated for by the better fibre productivity: 25% more long fibre than flax, and increased product reliability.

Enzyme retting has been introduced but the costs of the enzyme preparation in relation to its retting efficiency and the investment costs of equipment and waste water treatment systems compared to dew retting have been limiting factors for commercial use.

Within the EU fifth framework programme 'Quality of life and management of living resources' a new hemp variety, called Chamaeleon, was evaluated for its textile applications by Zignago Tessile spa acting in its role as textile partner of the multidisciplinary European research project HARMONIA (Hemp as a Raw Material of New Industrial Applications).

This variety is easily distinguished by its change of colour at maturity, the low THC level and above all, easy decortication. Chamaeleon is now included in the A list of european varieties covered by subsidies.

The preliminary results indicate that fibres obtained from the dew retting process and flax scutching line are finer, softer and cleaner than those coming from other standard varieties processed with water retting. This means that it could soon be possible to start employing this fibre at industrial level.

As a final consideration, I think that future textile applications for hemp fibres are promising and very close to being achieved. It will, of course, be necessary for the different parts of the agro-industrial production chain, that is farmers, fibre producers and product manufacturers, to make a co-ordinated effort in order to overcome the remaining limitations associated with hemp fibres when used in textile production. From this point of view the role played by the european institutional organizations becomes indispensable.

In closing I wish to thank the organizer Mr. Giampiero Venturi who so kindly gave me the opportunity to talk to you on this subject.

***Table 1*: European hemp cultivated surfaces – CELC data.**

	G	UK	A	S	F	NL	I	Other	EEC
1970-80	43	-	-	280	6651	-	-	254	**7227**
1980-90	4	-	-	543	4946	4	-	2	**5499**
1990	-	-	-	484	3707	-	-	-	**4191**
1991	-	-	-	720	3790	-	-	-	**4510**
1992	-	-	-	1050	3937	-	-	-	**4987**
1993	-	407	-	786	5867	1	-	-	**7061**
1994	-	872	-	547	6352	137	-	-	**7908**
1995	-	1119	160	1371	6149	933	-	-	**9732**
1996	1426	1697	661	1450	7588	893	-	7	**13722**
1997	2842	2304	1097	4200	10930	1337	-	185	**22895**
1998	3000	2000	1000	23000	9682	1500	-	1500	**41682**
1999	4003	2500	289	13473	9980	872	-	335	**31452**
2000	2967	2750	500	5713	7459	806	-	342	**20537**
2001	1911	1675	1300	851	6896	1100	200	9	**13742**

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