(ii) Project title : Development of value added product from di**ffe**rent Fibres in Himalayan Region (Sponsored by Ministry of Textiles, Govt. of India)

Objectives :

- To standardize a method for extraction of fibers from Pine • Needles, Indian Flax, Nettle etc.
- • Development of machines for extraction of fibres
- To produce yarn with pure fibres and blends by optimizing • mechanical parameters
- To develop various kinds of fabric utilizing those yarns
- To develop final value added products / home textile using • these fabrics
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Research outcomes

Cultivation of flax fibres has been done

- Extraction of fibre from Pine leaves has been standardized The machines identified for the project has been erected & commissioned at NITRA premises
- Machinery manufacturer has been identified and purchase process has been completed. Machinery
- procured is shown in Fig. 6
  A patent has been filed regarding extraction of textile grade fibre from pine needles
- Natural long fibre pilot plant consisting of Hackling Machine,
- Draw Frames, Speed Frames and Wet Spinning Ring Frames has been established and started
  Project has been completed and report has been sent to the
  Ministry of Textiles, Govt. of India
  Products have been developed (Refer Fig.7)

Fig.6 : Machinery procured

Fig. 7 : Some of the value added products developed

Background:

Life in hills is not easy-going due to limited sources of income. As a result of the same there is considerable migration of people from hills to plains in search of livelihood. As per report of Economic times (06.05.2018) approx 4 lakh people have migrated in past 10 years from their native villages of Uttarakhand.

In fact the Himalayan region has been bestowed with enormous nature's fibre wealth, including pine needles. These have been used by the locals for their general needs. The pine needles (perul), falling down on the earth in abundance, are highly inflammable when dry and catch fire leading to forest fires causing huge losses to the eco-system.

NITRA took an initiative to extract textile grade fibre from Pine needles and other such resources to develop value added products using these extracted fibres such as Ramie (Boehmeria Nivea), Flax (Linumusitatissimum) and Hemp (Cannabis sativa), etc. I t has been observed that the products developed from these fibres have very high probability of domestic and export demand. Indigenous flax fibres have quite satisfactory properties and can reduce / replace import of flax fibres from European countries.

Experimental work:

Experiments were carried out for exploring the possibilities of using natural fibres abundantly available in Himalayan region. Brief details of experiments are given below.

The pine needles were collected from the ground of Almora, Uttarakhand and neighbouring areas where Pine forests are abundantly available. Those needles were brought to NITRA, Ghaziabad and extraction of fibres was attempted. Various chemical combinations were tried to get the best textile grade fibres. Sodium hydroxide (NaOH) solution was used for preliminary treatment and then Aluminium chloride ($AlCl_3$) solution was used for final treatment. After a number of trials, optimum time, temperature and concentration (gpl) were finalised. Then the fibres were extracted by mechanically rubbing the treated leaves and dried.

For producing Indian Flax proper seeds were required. It was observed that Central Research Institute for Jute & Allied Fibres (CRIJAF) under ICAR had undertaken some trials and they have developed a variety of JRF2 which gives good result in Indian atmosphere. But large scale trials were not been taken for commercialization. NITRA procured seeds from them and planted in around 7 acres of land during 2017-18. Five acres of land was at G.B. Pant University of Agriculture & Technology, Pantnagar, Uttarakhand and around 2 acres of land was at NITRA, Ghaziabad. The sowing time was November end to beginning December 2017 and the plants were harvested during April, 2018. Fibres were extracted after retting and scutching was done.

Results & Discussion:

The properties of the extracted pine needle fibres were assessed. These are shown in Table-2 "Physical properties of Pine needle fibres". As the fibres have low tenacity value it was blended with cotton fibre and yarns were spun. The SEM photographs of the cross section of the pine needle fibres and longitudinal structure have been shown in Fig. 8 to Fig.11. Both Fig.8 and Fig.9 show the cross-sectional view of pine needle fibres at different magnifications. The figures show a hollow structure which is different from conventional natural fibres used in common. The Fig.10 and Fig.11 show the longitudinal view of pine needle fibres which are not fully cylindrical and somehow looks rough. It was observed that it has high moisture regain

value (around 12%). It is expected that this hollow structure will result in products with high thermal resistance value and good water absorbency.

Table 2: Physical Properties of Pine needle fibres

Parameters	Pine needles
Tenacity (g/den)	1.10
Min.	0.32
Max.	3.63
Average	1.10
CV%	66.80
Elongation%	5.94
Min.	0.80
Max.	10.10
Average	5.94
CV%	41.25
Count (Denier/Ne)	87.69/60.61
Bundle strength (g/tex)	5.64
Elongation%	6.9

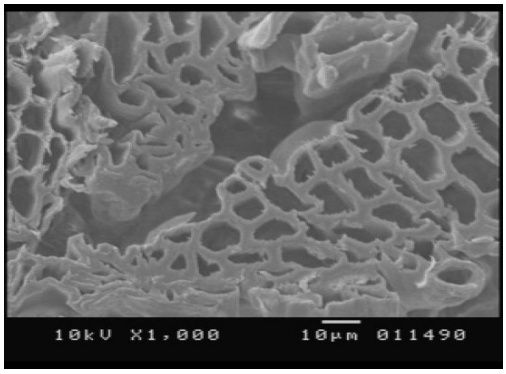


Fig.8

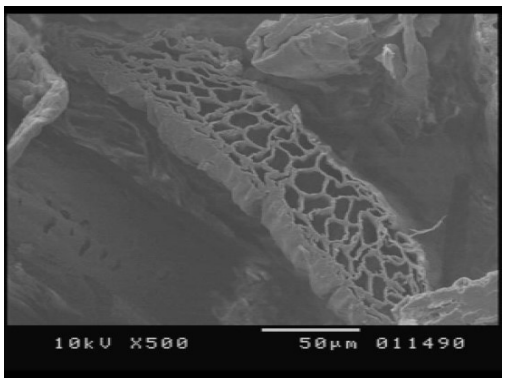


Fig.9

Fig.8 and Fig.9 show the cross-sectional view of pine needle fibres at different magnifications

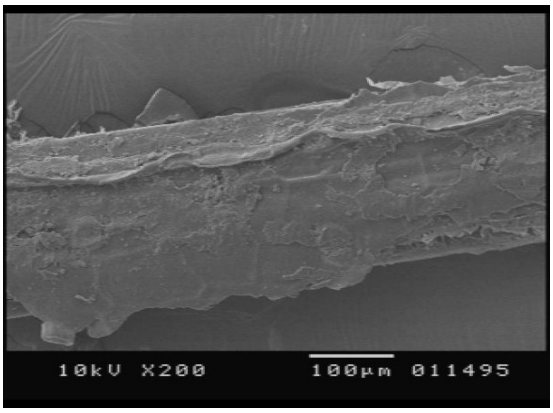


Fig. 10

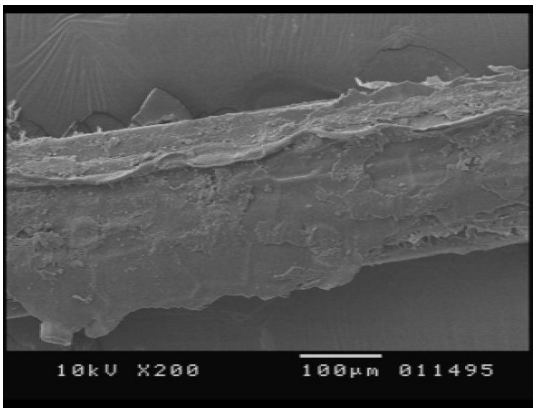
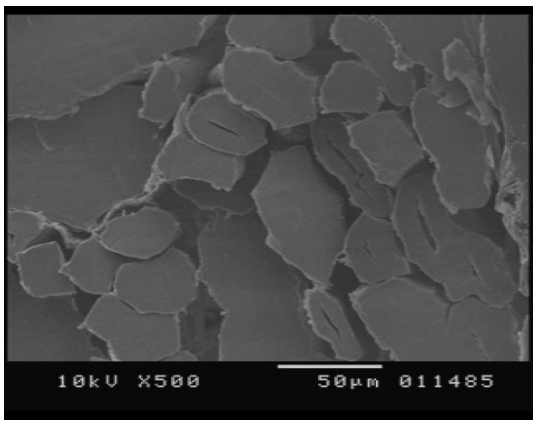


Fig. 11

Fig.10 and Fig.11 show the longitudinal view of pine needle fibres

The flax fibres, produced in India, were assessed for their various properties and the same were compared with the some of the European flax, sourced from a commercial fabric manufacturer. The SEM photographs of the flax fibres are shown in Fig. 12 to 15. Both Fig.12 and Fig.13 show the cross sectional view of the flax fibres and different magnification. It can be seen that the fibres are mature and similar to available fibres elsewhere. The Fig.14 and Fig.15 show the longitudinal view of Indigenous flax fibres at different magnifications. The properties are shown in Table-3. It can be seen from the Table that there is no significant difference in properties of these fibres. However, single fibre tenacity of Indian flax is lower than imported fibre, but the bundle strength of Indian fibre is higher. The appearance shows small difference and the Indian variety looks little harsher. This may be the reason for having higher bundle strength as compared to the bundle strength of imported fibres.



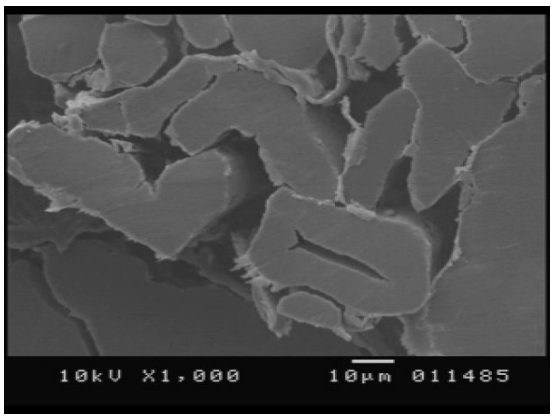
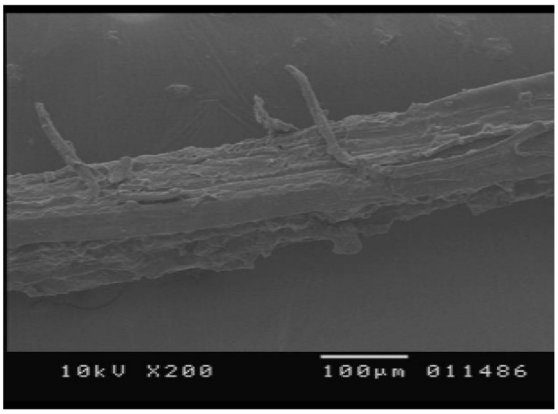


Fig. 12 **Fig. 13**

Fig.12 and Fig.13 show the cross sectional view of the flax fibres and different magnification.



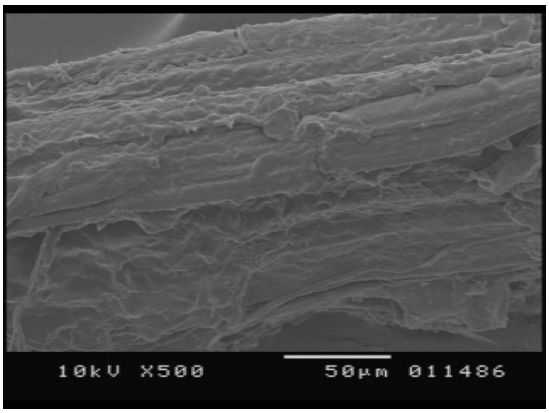


Fig. 14 **Fig. 15**

Fig.14 and Fig.15 show the longitudinal view of Indigenous flax fibres at different magnifications

Table 3: Physical Properties of Flax fibres

Parameters	Indian flax	Imported flax
Tenacity (g/den)	3.43	4.18
Min.	0.56	0.86
Max.	7.34	7.19
Average	3.43	4.18
CV%	48.77	42.05
Elongation%	2.11	2.26

Min.	0.70	0.70

Max.	4.50	4.40
Average	2.11	2.26
CV%	41.38	35.12
Count (Denier/Ne)	40.81/130.24	38.52/137.98
Bundle strength (g/tex)	63.49	40.82
Elongation%	0.61	0.75

The pine needle fibres (PNF) have been blended with cotton in different ratios and it was found difficult to spin yarn as the percentage of PNF fibres increases. Also it is observed that there is preferential loss of PNF in carding, resulting in less PNF percentage in resultant yarn. The yarns with 70:30 Cotton: PNF (actual in yarn stage) was successfully spun and yarns were sized and woven into fabrics using loom. The fabrics have unique look and it will be useful to produce home textiles and apparels.

The Indian flax fibres were processed in very small scale in a commercial company in Eastern India which is the leader in flax processing. The fabric produced in small scale was found as good as that of produced from imported flax fibre. This preliminary small scale trial showed that yield is much lower (to the extent of 50%) during spinning operation. This is due to improper extraction of fibre and scutching of Indian flax fibre. The scutching was done using crude manual method which needs to be improved to get better yield of yarn from fibre.

Findings of experiment:

The results show that there is a very good possibility of producing high value textile products using Pine needles which are abundantly available as plant waste and can help improve the economy of Himalayan region. Also it will help in reduction of forest fire which is the cause of huge loss of human and animal life.

Flax fibre produced in India can replace the use of imported flax fibre, thereby, reducing import and generating income for the people living in the Himalayan region.