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Constructional and physical properties of handloom union fabrics from plant waste material : China rose plant stems (*Hibiscus rosa sinesis*)

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ABSTRACT : The naturalism trend has led to establishment of sectors in the textile and fashion industry. Non conventional fibres have considerable potential to assist in the emerging "green" economy based on energy efficiency, industrial processes that reduce carbon emissions and recyclable materials that minimize waste. Natural fibres are a kind of renewable and carbon neutral resources; they absorb the equal amount of carbon dioxide, they produce. The china rose blended union fabrics were developed and their properties were studied. The results showed that the H_2 china rose/cotton 50:50 blended yarn exhibited higher count of 2.89s than 100 per cent china rose H_1 (0.73s).Thread count of H_1 and H_2 fabrics was 165×52 and 171×66/ sq inch, respectively. Higher weftwise breaking strength was observed in case of H_1 fabric (206 g) as compared to H_2, whereas 14.99±0.46 per cent elongation at break was higher in H_2 union fabric than H_1, *i.e.* 4.89±0.33 per cent. Thickness (2.81 mm) of H_1 fabric was more compared to 0.82 mm thickness of H_2 union fabric. The stiffness (3.50 mm) in case of H_1 union fabric was found higher than H_2, *i.e.* 1.76 mm in weftwise. Drape co efficient of H_1 (66.23%) was higher than H_2 union fabric. Both union fabrics were found suitable for apparel as well as home textiles.

Keywords: Blend, china rose fibres, cotton, union fabrics

Organically produced fibres are in demand by the global green textile industry and show potential which is economically promising. An insight into the cultivation practices leads to a conclusion that cotton, despite being a natural fibre, is one of the most unsustainable crops owing to the extensive use of fertilizers and pesticides in its production. Nearlym a quarter of all the pesticides used in the world are sprayed on the cotton plants. Besides, the other important natural fibre of silk is engulfed in a moral war of being cruel. Even though concepts like 'organic cotton' and 'ahimsa' silk have been well established. The costs and labour involved in their production are quite high (Anonymous, 2005). China rose (*Hibiscus rosa sinesis*) is a perennial evergreen shrub and can grow anywhere from 4 to 15 feet tall and 5 to 10 feet wide. The stem of china rose plant contains strong bast fibres. China rose is used for a wide variety of purposes, including the manufacture of furniture and nutritional products and medical purposes (Anonymous, 2013). It hardly requires any pesticides or fertilizers because it is resistant to all type of disease and insect pests.

Globally, textile industry has been looking for alternative fibres which can reduce heavy reliance on cotton. As a result, minor natural fibres like jute, hemp, linen, nettle, etc have gained popularity in commercial textiles since last two decades (Anonymous, 2011). Natural sources such as cotton, silkworm and sheep have offered relatively easy and managable fibres for refinement. New additions to the opened natural fibre market (not in history though) include hemp, jute, kneaf, flex, ramie and most notably bamboo. In addition to the technological advances in material innovations, fashion industry is also playing it's vital role as fashion design, is all about creativity and resourcefulness, pushing its creativity to new horizons. In the UK alone there are countless individual designers, either just starting out or more established, who only use 100 per cent certified sustainable eco fabrics (Catherina, 2010). However, no reports of china rose fibre extraction have been found in the literature. China rose can be considered as one of the latest, to be added in the list of possible commercial fibres. The present study was highlighted with the below mentioned objectives.

- To develop china rose union fabrics
- To study the constructional and physical parameters of extracted fibres and developed china rose blended union fabrics.

MATERIALS AND METHODS

Procurement of material : Pruned china rose waste stems were procured from Punjab Agricultural University, Ludhiana to extract the fibres. Cotton fibres for developing blended china rose yarn were procured from the Dev Woollen Mills, Ludhiana. The china rose fibres were extracted by chemical process. Cotton yarn of 2/20s and 2/30s yarns counts were procured from Dehradun market.

Extraction of fibres : Chemical extraction process was followed to extract the china rose fibres. Fresh china rose stems were washed with distilled water. To extract fibres from bark, the raw material was treated in 3 per cent NaOH solution keeping material to liquor ratio 1:20 at 100–120^0 C for 2.5 h and residue was rinsed thoroughly and neutralized with 5 per cent acetic acid. China rose, as bast fibre, was easily spinnable into pure yarns. These fibres were long, strong with comfortable soft hand, cream coloured, resistant and transpiring as the linen, and smooth textured as silk. These fibres were considered suitable for blending with cotton.

Development of blended china rose yarn : Blending, carding and spinning processes were carried out in Uttarakhand Bamboo Fibre Development Board (UBFDB), Dehradun for the development of yarns. To obtain the blend of china rose fibres with cotton fibres in the ratio of 50H:50C, the fibres were machine opened and fed into the blow room. These were carded in card rollers, roved and hand spun on *Charkha* (spinning wheel) to make 100 per cent china rose and 50H:50C yarns. The extracted fibres were suitable for hand spun due to thickness of the fibres and fabrics were developed for handloom products.

Details of developed china rose union fabrics : Two samples of blended union fabrics were developed using cotton yarns in warp direction. The china rose union fabric H_1 in regular twill (EPI=165, PPI=52) with cotton(2/10)/ china rose (0.73s), and fabric H_2 also in houndstooth twill (EPI=171, PPI= 66) with cotton(2/30)×china rose/cotton (2.89s) were handloom woven (Table 1).

Testing physical properties of blended union fabrics : The testing of physical properties of china rose union fabrics was done at North Indian Textile and Research Association (NITRA), Ghaziabad using standard testing methods. The union fabrics were tested for their physical properties such as breaking strength, elongation at break, thread density, thickness, stiffness and drapability, etc according to IS methods.

Constructional properties of the union fabric : Yarn count (IS: 1315-1977 (Reaffirmed 1999) and thread density (IS: 1963-1981).

Physical properties of union fabric: Breaking strength (IS: 1969-1985), elongation at break (IS: 1969-1985), thickness (IS: 7702-1985), stiffness (IS: 6490) and drapability (IS: 8357).

RESULTS AND DISCUSSION

Analysis of constructional properties of the union fabrics from china rose and cotton fibres ; The constructional properties of developed china rose union fabrics have been discussed below. The yarn count observed for developed china rose union fabric H_1 was 0.73s and H_2 2.89s, respectively (Table 2).

It was observed that H_1 union fabrics H_2 showed higher cloth count (171 x 66/sq inch) than H_1 (2/20 cotton x china rose) union fabric (165 x 52/sq inch). The fabric weight of H_1 was 485 g/m^2 and 06 H_2 320.18 g/m^{2,} respectively.

Table 1. Developed union fabrics with different yarns, composition, thread count and weave

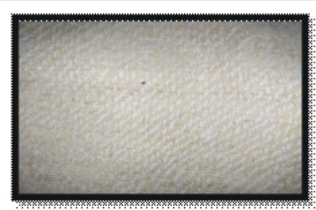
Union fabric code	Composition of warp yarn	Composition and thread count/ sq inch	Type of twill weave used	Images of woven samples
H_1	2/20 cotton	100 per cent china rose (0.73s)(0.73s)EPI=165, PPI=52	Regular twill 45 degree angle	
H_2	2/30 cotton	50 per cent china rose : 50 per cent cotton (2.89s) EPI=171, PPI=66	Houndstooth twill	

Table 2. Constructional properties of china rose union fabrics

Constructional properties		China rose union fabrics (H_1 and H_2)	
Fibre content	(warp)	Cotton fibres	
	(weft)	China rose fibres (100%)	China rose/cotton (50:50)
Yarn count (Ne)	Cotton yarns (warp)	2/20	2/30
	Developed yarns (weft)	0.73s	2.89s
Fabric structure	EPI	165	171
	PPI	52	66
	Fabric count (per sq inch)	165 x 52	171 x 66
Weave	Twill	Twill	
Cloth width	29"	29"	
Fabric weight (g/m^2)	485.00	320.18	

EPI= Ends/inch, PPI= Picks/inch

Changes in fabric mass weight may be due to variation in blend composition, yarn count, fabric thickness and fabric density. Besides this fabric density, twist of individual yarn and thickness significantly influence the weight of the fabric (Kariyappa *et al.*, 2007).

Analysis of physical properties of china rose union fabrics : The physical properties examined were fabric mass weight (GSM) breaking strength, elongation, stiffness, thickness, abrasion resistance and drapability of the blended union fabrics of pure two blend china rose yarns and cotton yarns (Anonymous, 2016).

Union fabric H_2 (2/30 cotton×china rose/cotton 50:50) exhibited the higher breaking strength (364.61±8.77 kg/cm^2) as compared to union fabric H_1 (2/20 cotton×china rose) which was 292.05±0.50 kg/cm^2 in warp direction.

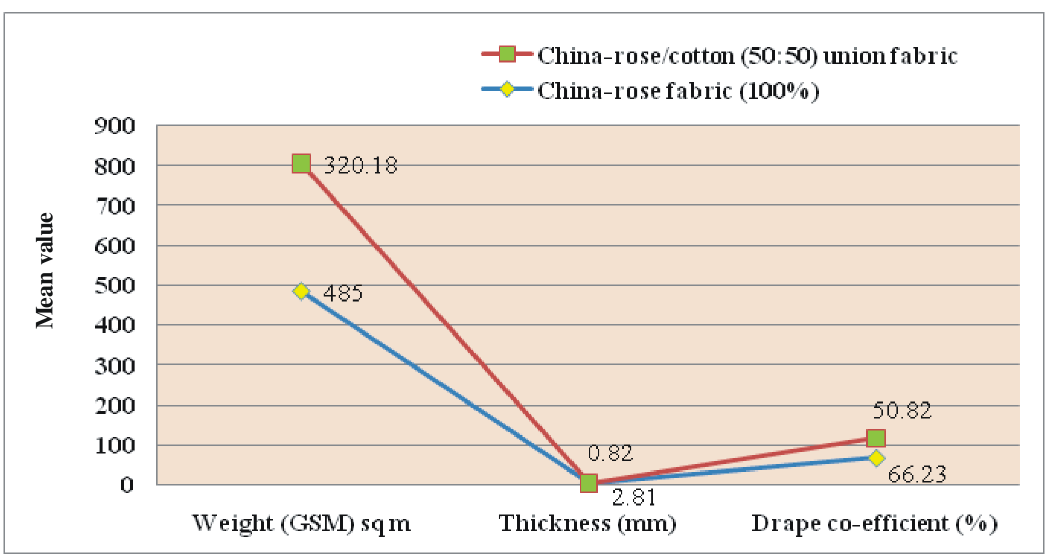


Fig 1. Physical properties of china rose blended union fabrics

Table 3. Physical properties of china rose union fabrics

Test parameters	China rose (100%) H_1	China rose/cotton (50:50) H_2	t value
Breaking strength (kg/sq cm)			
Warp (100% cotton yarn)	292.05 ± 0.50	364.61 ± 8.77	7.33*
Weft (developed yarns)	206.00 ± 5.80	192.80 ± 0.14	5.57*
Elongation at break (%)	20.30 ± 0.70	18.87 ± 1.39	1.916
Warp (100% cotton yarn)	4.89 ± 0.33	14.99 ± 0.46	12.145*
Weft (developed yarns)			
Thickness (mm)	2.81 ± 0.05	0.82 ± 0.01	54.35*
Stiffness (mm)			
Warp (100% cotton yarn)	1.50 ± 0.07	1.55 ± 0.06	1.27
Weft (developed yarns)	3.50 ± 0.14	1.76 ± 0.13	8.61*
Drape co efficient	66.23 ± 2.66	50.62 ± 3.11	35.477**

t value=calculated value of two mean differences, **,*=Significant at 5 per cent and 1per cent level of significance, respectively.

Note: *C=Cotton *H=china rose

H_1= China rose (100%), H_2= China rose/cotton (50:50)

Breaking strength of H_1 (206.00±5.80 kg/cm^2) fabric (2/20 cotton×china rose) was found to be higher in weft direction. The mean difference in weftwise breaking strength (5.57%) for H_1 and H_2 union fabrics was found to be significant. This may be due to difference in linear densities of fibres. The abrasion for H_1 and H_2 exhibited no thread break upto 10,000 cycles (9 kpa pressure). Thus, fabrics can be suitable for heavy duty industrial and home textiles. The abrasion for nettle blended fabrics was persisted at 1311 cycles and 1704 cycles was considered good for heavy textile products like jackets, rug, stole, etc (Garg, 2017).

The union fabric H_1 (2/20 cotton×china rose) exhibited higher elongation in warp direction as compared to H_2 fabric (2/30 cotton×china rose/cotton 50:50). But in the weft direction, H_2 fabric (2/30 cotton×china rose/cotton 50:50) was having higher elongation in comparison to H_1 fabric (2/30 cotton×china rose). The observed mean value of elongation at break of H_1 fabric in warp direction was (20.30±0.70), whereas in case of H_2 union fabric was 18.87±1.39 per cent. Besides, the mean value of elongation at break H_2 and H_1 in weft direction was 14.99±0.46 and 4.89±0.33 per cent, respectively. The mean difference in elongation at break of the union fabrics in warp direction was found to be non significant. But the difference in the mean values for elongation at break in weft direction was observed to be significant (12.145%). The thickness of union fabrics H_1 and H_2 was found 2.81±0.05 mm and 0.82±0.01 mm, respectively. The difference in the thickness of H_1 and H_2 union fabrics was significant at 5 per cent level.

The stiffness (1.55±0.06 mm) of union fabric H_2 (2/30 cotton×china rose/cotton 50:50) was found to be higher as compared to H_1 fabric (1.50±0.07 mm) in warp direction which was found to be non significant. In case of the weft direction, stiffness (3.50±0.14 mm) of union fabric H_1 was observed to be higher than H_2 fabric (1.76±0.13 mm). The calculated t value showed that the difference between the stiffness (1.27 mm) of union fabrics H_1 and H_2 was non significant. Stiffness of union H_1 and H_2 fabrics in weft direction was differed significantly at 8.61 per cent at 5 per cent level. The higher drape coefficient (66.23%±2.66) of union fabrics H_1 (2/30 cotton×china rose) was found as compared to union fabric H_2 (50.62%±3.11). The lower value of drape coefficient for H_2 (2/30 cotton×china rose/cotton 50:50) was responsible for its better drapability.

CONCLUSIONS

China rose fibres lend considerable weight, bulk and stiffness to the fabric. Thus, union fabrics of china rose with higher fabric weight and thickness were good for making home textile products *viz.,* rug, table runner and cushion cover because these would retain shape well and, resist slippage and folds in use. The developed union fabrics revealed high abrasion resistance making them suitable for many industrial uses.

REFERENCES

Anonymous, 2005. Fibres from nettle and hemp wild fibres natural fibres. *http://www.h:/Natural.htm* (Retrieved on Oct 14, 2013).

Anonymous, 2011. *Himalayan Nettle.* Uttarakhand Bamboo and Fibre Development Board (UBFDB). Uttarakhand, India.

Anonymous, 2013. Charactistics features of China rose. *http://homeguide.sfgate.com/characteristics-features-of-*china rose*.html* (Retrieved on Feb 2018).

Anonymous, 2016. Northern India Textile Research Association (NITRA) *www.nitratextile.org* (retrieved on August 27, 2016).

Catherina, 2010. *A feasibility study for wood fashion.* Pp 13-15 Technology Project, Catharina Eden Ltd. Lahti, Mikkeli and Lappeenranta Universities.

Garg, N. 2017. "Utilization of Himalayan nettle (*Girardinia diversifolia*) for designing handloom textile products" *Ph.D. Thesis*, Punjab Agricultural University, Ludhiana.

Kariyappa, Shillin, N., Ramaswamy, G. N., Roy, S., Somashekhar, T. H. and Rao, P. M., 2007. Effect of mechanical raising on low stress, surface properties total hand value of white eri spun silk fabric.*Man Made Text* **50:** 54-57.

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