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Formulation of Grading Parameters and Grading System of Sisal Fibre (*Agave sisalana*)

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Abstract—*Sisal fibre* *(Agave sisalana) is derived from the leaves of the plant. The leaves are long, straight, dark green, pointed and often covered with a waxy bloom. The leaves contain 90 percent moisture and 3 to 5 percent fibre depending on the age of the plant. It is usually obtained by machine decortications in which the fibre is removed by scraping away the pulpy material by a mechanical decorticating process. The fibre strands are washed and air dried. Sisal fibre is fairly coarse and inflexible. In India there is no BIS approved Sisal Grading System. For marketing purpose the fibre quality and grading is essential. Growers are deprived by the purchaser due to non-availability of BIS grading system. It is valued for cordage use because of its strength, durability, ability to stretch, affinity for certain dyestuffs, and resistance to deterioration in saltwater. Sisal fibre can be processed in paper industry of its high cellulose and hemicelluloses content. The higher grade fibre after treatment is converted into yarns and used by the carpet industry. Sisal Fibre is graded in three grades considering strength, reed length, colour, fineness and defects. Therefore keeping the interest of the growers and traders the Sisal grading system has been developed.*

Keywords*:* *Sisal, grading, strength, fineness, colour, defects*

1. INTRODUCTION

Sisal (*Agave sisalana*) is a hard fibre extracted from the leaves of sisal plants which are perennial succulents that grows best in hot and dry areas. Sisal is an environmentally friendly fibre as it is biodegradable and almost no pesticides or fertilizers are used in its cultivation. Propagation of sisal is generally by using bulbils produced from buds in the flower stalk or by suckers growing around the base of the plant, which are grown in nursery fields until large enough to be transplanted to their final position. Sisal plants grow fast and all round the year. The first harvest can be made when the plants are about two years old and they remain productive for 10 to 12 years. Each plant produces 180 to 240 leaves in a lifetime yielding up to 4 tonnes of fibre per hectare. Sisal cultivation is a labour intensive crop and it offers employment to rural communities in area which are often not suitable for other crops.

It is usually obtained by machine decortications in which the leaf is crushed between rollers and then mechanically scraped. The fibre is then washed and dried by mechanical or natural means. The dried fibre represents only 4% of the total weight of the leaf. The fibre lies along the length of the leaf, being most abundant near the surface of the leaf where it is long and strong. The interior fibres are weaker, and they are usually removed during processing. Once it is dried the fibre is mechanically double brushed. World production is about 3 lacks tonnes. The lustrous strands, usually creamy white, average length from 80 to 120 cm.

Fibre is extracted by a process known as decortications, where leaves are crushed, beaten, and brushed away by a rotating wheel set with blunt knives, so that only fibres remain. After washing in water the fibres are dried in sunlight. Proper drying is important as fibre quality depends largely on moisture content. Fibre is subsequently cleaned by brushing.

Traditionally, sisal has been the leading material for agricultural twine because of its strength, durability, ability to stretch, affinity for certain dyestuffs, and resistance to deterioration in saltwater. The importance of this traditional use is diminishing with competition from polypropylene and the other synthetic products. For marketing and for growers benefit grading is important.

2. MATERIALS & METHODS

At farmers' level "hand & eye" method for sisal fibre grading is appropriate and quick also. Testing of fibre is done by hand and a close look at the fibre. But for setting the parameters fibre was tested in testing instruments and compares the results with hand & eye method. Accordingly appropriate score marks are assigned on these properties based on a 100 point score card and the total score indicates the grade of fibre.

Measurement of fibre parameters for grading

Length: Length of the fibre reed was measured with scale. Good length has some value in industrial handling because it helps good feeding on breaker card. Moreover, it helps to maintain uniformity and regularity in the sliver. Reed length depends on harvesting time. The average reed length is 80 cm

to 100 cm as per harvesting time. Score marks and sub-groups of parameters are given in Table-1.

Strength: Bundle strength of fibre is measured in hand & eye method by gripping a bundle of 10-15 fibres from the middle of the reed between the thumb and forefinger of both hands and broken longitudinally without jerk. It gives an idea of fibre strength. Instrument was also developed for strength test. Strength has three sub-groups i.e. high, medium, and average, and score marks are 30, 20, 15 respectively.

Fineness: It is a measure of diameter or thickness of the fibre. Fineness is expressed by mass per unit length in tex (gm/km) unit. The finer the fibre better is the quality. In hand & eye method, fibre fineness can be estimated simply by a close look at the fibre. Instrument was also developed for fineness determination. Fineness has three sub-groups i.e. fine, coarse, and very coarse and score marks are 15, 10 and 5 respectively.

Colour: Colour is the property of the fibre which distinguishes its appearance and imparts the aesthetic appeal of fibre. Different varieties of sisal fibre are found in different colour shades like light brown, brown etc. Colour of the fibre can be determined through visual assessment. Colour has three sub-groups and the score marks are 15, 10, and 5 respectively.

Defects: Factors causing serious or partial damage to the quality of fibre are commonly known as defects. It can be estimated through visual look at the fibre bundle. Minimum defects contain in the fibre is the better quality. The defects may originate in the field during growth, processing of plant to fibre, and during transit and storing. The main defects are:

Mats: Spots of dry bark adhering to the body of the fibres are called mats.

Leaf: Spots of dry leaf, which sometimes appear in the fibre strand, may create problem during processing.

Husk: Paper like substances adhere on the fibre is called husk

Dazed Fibre: If the fibre is stored with excess of moisture without proper sun drying, the fibre will have a dazed appearance.

3. RESULTS & DISCUSSION:

Presently, Sisal fibre is harvested two times in a year i.e., after six months. To get the better fibre 4 times in a year i.e., after 3 months intervals is best but the production will be hampered. So two times i.e., after six months is the ideal one for quality as well as productivity. Tested 100 different Sisal samples received from different places. It was found that reed length of the fibre varies and accordingly divided the length parameter into three sub-groups and score marks were allotted accordingly. Because good length has some value in industrial handling since a 'morah' of good length requires less operatives to handle and it also helps goods feeding on breaker card. In case of strength which measures the ability of fibre to withstand stress in the longitudinal direction is an important factor. Studies showed that strength varies from 20 g/tex to 30 g/tex and divided the strength parameter into three sub-groups and score marks were allotted accordingly. Irregularity of yarn is dependent on fibre fineness and its variation. For making yarns of finer count this characteristic of fibre is gradually becoming more important. So fineness has been taken into account and divided the parameter into three sub-groups and score marks were allotted accordingly. Generally Sisal fibre is available in three colours like Creamy White, Yellowish White and Creamy to pale greenish. Score marks were given accordingly. Serious or partial damage to the quality of fibre are commonly known as defects. Basically defects were measured by close look to the fibre reed. Four types of defects were observed and identified which is given in the defects parameter. Defects were divided into three sub-groups like, less, medium and high and score marks were allotted accordingly. Total score marks and grading has been given in Table-1. Weightage for each of the five parameters of Sisal fibre mentioned above were given according to their importance with reference to end product quality. Total score marks of 100 have been distributed for the five parameters accordingly. The best quality Sisal fibre i.e., SL-1 has been awarded total score 100. Score marks 70 for SL-2, and score marks 45 for SL-3 given in Table 1.

4. CONCLUSION

In India, the Sisal production is going down due to its price and market availability. In view of the above prospects of increased production and utilization of the fibre, a grading system for the Sisal fibres has been devised on the basis of fibre qualities which mainly decide the grade of fibre. The grading system of the fibre will help the farmers as well as the users and other stakeholders in the industry in marketing and specific utilization of the fibre in diverse areas.

Table 1: Score marks and grade of Sisal fibre

Grade	Length (cm)	Strength (g/tex)	Fineness (tex)	Colour	Defects	Total
SL-1	≥ 90 (20)	≥ 25 (30)	≤ 10.0 (15)	Creamy White (15)	Minimum (20)	**100**
SL-2	< 90 - 75 (15)	< 25 - 20 (20)	> 10.0 – 15.0 (10)	Yellowish White (10)	Medium (15)	**70**
SL-3	< 75 (10)	< 20 (15)	> 15.0 (5)	Creamy to pale greenish (5)	Maximum (10)	**45**

Figure 1: Sisal Field