

SISAL : IMPROVED PRODUCTION TECHNIQUE



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IMPROVED PRODUCTION TECHNOLOGY OF SISAL

INTRODUCTION

Different species of *Agave* (Asparagaceae family) namely *Agave sisalana*, *Agave cantala*, *Agave vera-cruz*, *Agave amaniensis*, *Agave angustifolia* and *Agave fourcroyodes* can produce hard fibre from its leaf. Sisal (*Agave sisalana* Perrine ex Engelm., Family: Asparagaceae) is a native of the Yucatan area of Mexico where the fibre had been used by the native Mexican people for centuries. Later, around 1836, sisal was introduced to Florida. Other than Mexico, wide cultivation of sisal was started in Tanzania, where it was introduced by Dr. Richard Hindorf, an Agronomist from Germany in 1893. In the present world, major sisal producing countries are Brazil, Tanzania, Kenya, China and Mexico (Table 1).



Field view of sisal plantation in India



Sisal is a xerophytic, monocarp, semi-perennial leaf fibre producing plant. The plant has short stem bears rosette of leaves that are sessile, linear lanceolate attains a length of 1-1.5 m or more. The leaves are thick, fleshy and often covered with waxy layer, typical characteristics of xerophytic plants. The life span of this crop is generally 10-12 years having the leaf of 1-1.2 m length and 10-16 cm width at maturity with fibre output of 2-5% of green leaves.

This versatile crop is strongly potential to upscale and provide a sustainable source of income to marginal and poor farmers in plateau regions and the farmers who live in drought prone parts where other agricultural crops face considerable challenges.

TABLE - 1. AREA, PRODUCTION AND PRODUCTIVITY OF SISAL IN THE WORLD (2010)

Sl. No.	Country	Production (10 ³ t)	Area (10 ³ ha)	Productivity (Kg/ha)
1.	Brazil	280.00	273.27	1024
2.	Kenya	16.15	36.5	442
3.	Tanzania	23.80	53.77	442
4.	Mexico	11.12	26.09	426
5.	China	16.50	3.40	4853
6.	Others (Madagascar, Haiti, Morocco, South Africa, Mozambique etc)	33.86	48.72	695
	World	381.43	441.75	863

<http://faostat.fao.org>

CLIMATIC REQUIREMENT

Sisal is well adapted in arid and semi-arid regions in India, mainly in Odisha, Jharkhand, Maharashtra, part of Bihar, western part of West Bengal and many southern states where the annual rainfall varies from 60-125 cm with temperature 40-45°C. As water is valuable input in arid and semi-arid regions, so drip irrigation and sisal composting gave encouraging results.

SOIL

Sisal thrives best on dry, permeable, sandy-loam soils with good amount of liming materials (Ca and Mg) but can also grow on various other types of soils. In India it is grown in light calcareous and gravelly soils with good drainage. Heavy soils having possibility of water logging are not suitable as the condition causes pale and stunted growth of sisal. Adequate calcium in soil promotes development of the root system.

PLANTING MATERIAL

Growth of sisal plant is terminated with the emergence of flowering stalk known as 'pole'. Fruits are seldom formed as flower shrivel and fall owing to the formation of an abscission layer at the top of the pedicel and therefore, setting of seeds is not common. Sisal is mainly propagated by vegetative means such as 'bulbils' and 'suckers'. Bulbils develop from tiny buds present on each flower stalk. A bulbil is a plantlet consisting of a meristem, 4-7 reduced leaves and rudimentary adventitious roots. A pole of a sisal plant may produce 200-500 or more bulbils. These bulbils develop and attain a size of 4-5 cm when they are collected during mid February to mid April and raised in nurseries.



Mature plants with pole



Sisal bulbils

The underground adventitious shoots that develop from the roots receive favourable condition, often come up at some distance from the parent plant above the soil surface and develop into small plants known as 'suckers'. After few months nurturing, these suckers are also used as planting material for new sisal plantation.

A sucker suitable for planting in the main field should be greater than 30 cm length, atleast 250 g weigh, has 4-5 leaves and free from any disease and/or stress symptoms.



Sisal Suckers

NURSERY MANAGEMENT

The freshly collected bulbils are raised in nurseries with an intention to produce high quality planting materials in shortest possible time. The selected land for nursery should be well drained, fertile (with organic matter), flat as far as practicable and situated near the irrigation source. Pulverized and airy soils accelerate quick initiation of roots and root development occurs rapidly.

In sisal two types of nurseries are in practice:

PRIMARY NURSERY

Primary nurseries are raised to rear fresh bulbils with intensive care and management during 3-4 summer months. The spacing should be closer to accommodate more plants in a small area and are generally spaced 10 X 7 cm in



Field view of Primary Nursery



Weeding in primary nursery

flat raised beds of 1 m width. In general, N, P and K @30:15:30 kg/ha is applied in addition to organic matters. Organic and inorganic mulches showed encouraging growth of sisal in limited or non-irrigating situation. Bulbils are very much sensitive to weed competition at the early growth phase. The nurseries should be kept relatively weed free.

SECONDARY NURSERY

Bulbils are transferred from primary nursery to the main nursery. The roots of the plantlets from the primary nursery are pruned lightly and the diseased & dead leaves are removed. Bulbils are treated with Cu-fungicide before planting them into the main nursery. Planting in main nursery is started with the onset of monsoon and completed as early as possible. A spacing of 50 x 25 cm was found better for rapid development of sisal plantlets. Every 11th row is skipped to get space facilitating weeding and other inter-cultural operation. The recommended spacing of 50 x 25 cm can accommodate 80,000 bulbils/ha of which about 72-76 thousand ultimately survive for planting in the main field.



Planting and inter-cultural operation in secondary nursery

PLANTING IN THE MAIN FIELD

The planting materials should not be kept in heaps. It may be kept for 30-45 days on soil under shade in single layer without any adverse effects on growth and fibre yield.

LAND PREPARATION

Being a xerophytic and hardy crop, lands available for sisal cultivation are often sloppy, eroded and most of them are without any vegetation cover. So, it is not advisable to plough-open the whole area encouraging further erosion. Pit planting is recommended for such land situation.



Pit digging in the main field for sisal plantation

SIZE OF PITS

Pit size of one cubic ft (1 ft³) is preferred for getting fast and uniform growth of sisal plants. Pits are dug during summer months and filled up with soil-organic matter mixture.

PLANTING METHOD

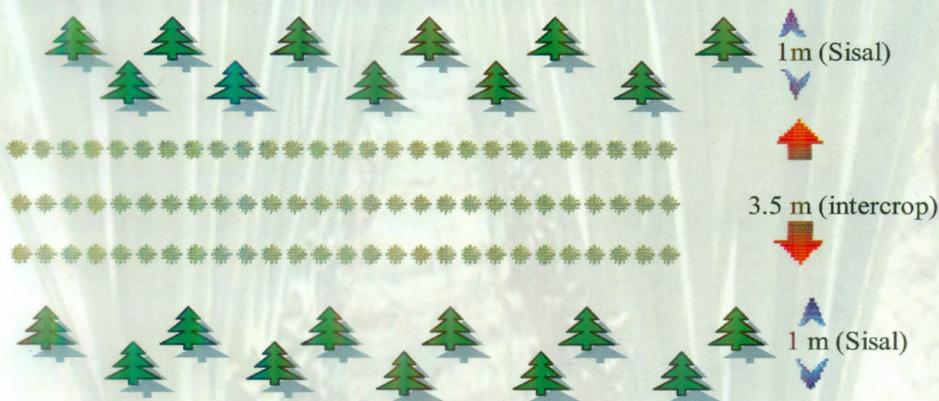
Two methods of planting are followed. Single row planting method is conventionally practiced and is less profitable. Whereas, double row planting method has several merits including checking soil erosion, accommodates more plants/ha and gives higher yield. Rows are made across the soil slopes.



Double row planting method

SPACING

Plant density depends on nature and fertility status of soil, type of farming, investment and management capacity of the grower. The following spacings are suitable: 4 m + 1 m x 1 m (4000 plants/ha); 3 m + 1 m x 1 m (5000 plants/ha); 3.5 m + 1 m x 1 m spacing, which accommodates 4,400 plants per ha.



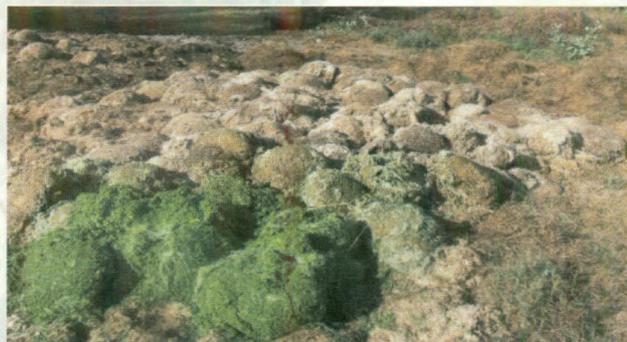
Schematic diagram of double row planting system (3.5 m + 1 m X 1 m)

TIME OF PLANTING

Planting should be taken up with the onset of monsoon i.e., Mid June to first fortnight of July, so that plants get sufficient time to establish well during the favourable rainy season.

MULCHING

Sisal waste can be used as good mulching material to conserve soil moisture. It can also improve soil conditions and adds nutrients to the soil. Mulching can also be practiced by using locally available grasses and other weeds before flower or seed formation.



Sisal Compost

INTER-CROPPING

The optimum spacing for planting of sisal is 3m + 1m x 1m, which accommodates 5,000 plants per ha, but this inter row space (3m) is not enough to drive tractor for ploughing within inter row space. Recently 3.5m + 1m x 1m spacing, which accommodates 4,400 plants per ha, is practised as it makes easy to plough the space



Sisal-pulses inter-cropping



Sisal-mustard inter-cropping

between rows with tractor for growing different intercrops. From an investigation it has found that several pulses like Green gram (*Vigna radiata*), Black gram (*Vigna mungo*), horse gram (*Macrotyloma uniflorum*) can successfully be grown during kharif season without irrigation and produced 5-8 quintals per ha grain yield and Toria/Mustard can be grown during rabi season with life saving irrigation and it has synergistic effect on fibre yield of sisal.

Profitable sisal based inter-cropping systems:

Sisal + Green gram
Sisal + Pigeon-pea

Sisal + Black gram
Sisal + Mustard/Toria

Sisal + Horse gram

AGRO FORESTRY WITH SISAL

Different sisal species are feasible to grow as intercrop with forest trees. From an investigation at Sisal Research Station, Bamra, a distinguishable response had found while sisal (*Agave sisalana* & hybrid sisal cv. Bamra hybrid 1) were planted in double row system in between two rows of teak (*Tectona grandis*, Linn f., Family Lamiaceae) and gamhar (*Gmelina arborea* Roxb., Family: Verbenaceae) in all possible combinations such as teak + *A. sisalana*; gamhar + *A. sisalana*; teak + Bamra hybrid-1; gamhar + Bamra hybrid-1 and sole sisal (*A. sisalana* & Bamra hybrid-1). Average fibre yield of *A. sisalana* was more when grown with gamhar (1027 kg/ha) than with teak (932 kg/ha). Similarly, Bamra hybrid-1 also gave more fibre yield with gamhar (946 kg/ha) than with teak (709 kg/ha). In all cases of *A. sisalana* and Bamra hybrid-1 growing with teak and gamhar, the fibre yields were reduced as compared to sole sisal plantation (without shade).



Inter-cropping of sisal with teak and gamhar

FERTILIZER APPLICATION AND OTHER INTER-CULTURAL OPERATIONS

Sisal in general is a nutrient demanding crop as 1 t of sisal leaves removes 23.5 kg N, 3.5 kg P, 35 kg K, 81 kg Ca and 30 kg Mg from the soil [Soil Use and Management Vol. 10]. Application of fertilizers should be done according to the fertility status of the soils and resources at disposal. In general, sisal growing soils are poor in fertility with acidic pH range. N, P and K fertilizers @ 60:30:60 kg/ha/year and Sisal compost/Cow dung/FYM (Depending upon availability) @ 5-10 tonnes/ha is recommended for medium fertile, normal soil condition.



Fertilizer application in main field

remain attached with fibre during extraction process. Usually the dried fibre shows slight greenness in colour. To make fibre white, next day this greenish fibre is spread under the direct sun light on the cement or grass floor. The green colour bleached quickly to whiteness in presence of moisture; hence, water is sprinkled over fibre to accelerate the bleaching process. On completion of drying, fibre is collected in small bundles and then baled for transportation and marketing.



Baling of sisal fibres

YIELD

The average yield of sisal fibre in India is poor and does not exceed 600 kg/ha. But with proper care and attention and by using improved cultivation techniques, the fibre yield could be achieved to 1.2 t/ha. Sisal plantation can earn yearly net profit of Rs. 33,000 per ha.



Dried sisal fibre



One bale (100 kg) sisal fibre

PLANT PROTECTION MEASURES

Zebra diseases of sisal are associated with three different species of *Phytophthora*, viz. *P. nicotianae*, *P. arcae* and *P. palmivora*. Dark black, water soaked lesions with concentric wavy rings appear on the leaves. The older leaves touching moist soil are more susceptible to infection. In both *A. sisalana* and Bamra hybrid-1, Zebra leaf spot appear as small lesions on the lamina, which rapidly enlarge into alternate concentric rings with light greenish yellow margin. Two foliar spray of Ridomil MZ-72 or Indofil M-45 @ 2.5 g/L of water at 15 days interval is recommended to manage this disease.



Symptom of Zebra disease

USE AND UTILIZATION

Traditionally, sisal has been the leading material for agricultural twine (binder twine and baler twine) because of its strength, durability, ability to stretch, affinity for certain dyestuffs, and resistance to deterioration in salt water. But the importance of this traditional use is diminishing with competition from polypropylene and the development of other hay making techniques, while new higher-valued sisal products have been developed. Apart from ropes, twines, and general cordage, sisal is used in low-cost and specialty paper, dartboards, buffing cloth, filters, geotextiles, mattresses, carpets, handicrafts, wire rope cores, and Macrame. The high grade fibre after treatment is converted into yarns and used by the carpet industry.

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