

## **Agro textiles - Their applications in agriculture and scope for utilizing natural fibers in agro tech sector**

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### **ABSTRACT**

Agro textiles, involves all the textile goods intended for being used in the agrarian production with direct implication in the agro-technical practice. Application of textile materials in agriculture is growing fast. They are termed as “Farm to Folk” products. Agro textiles help to keep sufficient soil humidity and increase the soil temperature, protect the harvests of fruits against the damage caused by the hail. Use of agro textiles like sunscreen, bird net, windshield, mulch mat, hail protection net, harvesting net, etc are gaining popularity now-a-days. Though manmade fibres (like poly-olefins) are preferred for agro textiles than the natural fibres mainly due to their favourable price performance ratio, light weight with high strength and long service life, but natural fibres can be used in agro textiles in some specific arena where characteristics like high moisture retention, wet strength, biodegradability are effectively exploited.

**Key Words :** Agro textiles, Agriculture, Plant protection, Crop yield, Natural fibres

### **INTRODUCTION**

Agriculture has been amongst the most primal occupations of the humankind and is still a major industry, globally. The stress on the production of agricultural crops has been increasing substantially with the continuous rise in world population. Present situation demands high yield and quality of agro-products in order to meet this rising need of population with limited land resource. However, the traditional way using pesticides and herbicides to achieve this stringent need is difficult. Moreover these methods are expensive and have long lasting ecological impact on soil as well as in living beings and agro-products.

With increasing environmental awareness and specified knowledge of various interdisciplinary technologies, considerable attention has been given on non-conventional technical applications like using textile structures in agriculture and horticulture sectors to enhance quality and yield of the agro-products. Textile structures in various forms are used in shade house, green house and also in open fields to control environmental factors like temperature, water and humidity. Use of agro textiles like sunscreen, bird net, windshield, mulch mat, hail protection net, harvesting net, etc are gaining popularity now-a-days. The Agro textiles sector

**Cite this Article:** Bhavani, K., Mallikarjun, Ningdalli and Sunilkumar, N.M. (2017). Agro textiles - Their applications in agriculture and scope for utilizing natural fibers in agro tech sector. *Internat. J. Appl. Home Sci.*, 4 (7 & 8) : 653-662.

is one of the forerunners within technical textiles. Agro textiles are textiles used for their functional benefits in the agricultural field. The agriculture and horticulture industries have realized the need to pursue various technologies to get higher overall yield and better quality agro-products.

Agro textiles, involves all the textile goods intended for being used in the agrarian production with direct implication in the agro-technical practice. “Agro textiles” now is used to classify the woven, nonwoven and knitted fabrics applied for agricultural and horticultural uses covering livestock protection, shading, weed and insect control, and extension of the growing season including agri-produce packaging. Hence, Agro textiles are termed as “Farm to Folk” products. Agro textiles help to keep sufficient soil humidity and increase the soil temperature, protect the harvests of fruits against the damage caused by the hail. The essential properties required in agro textiles are strength, elongation, stiffness, resistance to sunlight and resistance to toxic environments. All these properties help with the growth and harvesting of crops and other foodstuffs. With growing diseases due to various chemicals in food, vegetables, etc. due emphasis is laid on organic foods today. These are best achieved with controlled regulation of water, sunlight, and composts, duly made effective by use of agro textiles.

#### **Need for agrotextiles:**

Cultivation has been mainly booming in meeting the world’s effectual requirement for food. Until now more than 800 million public remain food insecure, and the outlook of food is more and more in doubt. Climate alteration, ecological degradation, increasing competition for land and water, high energy charge, and uncertainties about future acceptance rates for new technologies all present enormous challenges and danger that make predictions complicated. For e.g. to meet up expected demand, cereal production will have to boost by nearly 50 per cent from 2000 to 2030. Along with this global state of affairs let us reflect on the world Agricultural situation and evaluate how Agro textiles can play an essential role in adding up a ray of expectation to the above situation. The increase in food demand and need is the result of the mutual effects of world inhabitant’s growth to over 9 billion by 2050, rising incomes and dietary changes towards higher meat intake.

These agro textiles prevent the soil from drying out and thereby increase crop yield. Also it enhances freshness in fruits, vegetables and gives farmers and consumers value for their money. They improve product quality. Agro textiles protects farmer from harmful pesticides. Thermal protection textiles are treated with ultraviolet ray stabilizers. The best-known products are shade netting and thermal screens, the use of which can save up to 40% on energy in heating greenhouses. Their use improves the quality of fruit, prevents staining and improves uniformity of colour. Preliminary studies have shown that by using woven of return gauze it is possible to increase the harvest of fruits in a 30% under favorable conditions of time and up to 50% under unfavorable conditions. The agro textiles are also used to prevent the growth of injurious weeds to agriculture.

#### **Factors influencing agricultural activities :**

1. Sunshine – direct and indirect

2. Water
3. Climatic circumstances including wind, hail, humidity
4. External factors like birds, insects, wild plant
5. Post harvest handling of produce – storage and packaging

**Agro textiles :**

Application of textile materials in agriculture is growing fast. Textile materials in the form of woven, nonwoven, knitted, knotted, twine, braided, etc. are used for various applications of agro textiles. Woven and nonwoven structures are generally used for ground covers, mulch mats, shades; braided and woven structures are used for sapling bags; warp knitted structures are used for screens, nets and packaging materials; knotting technique is used for manufacturing fishing nets.

**Properties required for agro textiles :**

- Performance ratio
- Ease of transport.
- Space saving storage.
- Long service life.
- Resistance to solar radiation.
- Resistance to ultraviolet radiation.
- Biodegradability.
- High potential to retain water.
- Protection property.

**Type of agro tech products and their application arena :**

Agro textiles can be classified according to areas of applications. These areas are broadly identified as :

- Agro textiles for crop production.
- Agro textiles for horticulture, floriculture and forestry.
- Agro textiles for animal husbandry and aqua culture.
- Agro textiles for agro-engineering related applications

Some of the agro textiles that are used frequently are as follows:

1. Shade net.
2. Plant net.
3. Bird net.
4. Insect net.
5. Landscape fabric.
6. Sapling bags/sleeves for saplings.
7. Mulch net.
8. Hail protection fabrics.
9. Rain protection fabrics.
10. Wind control fabrics.
11. Harvesting nets.

12. Textile materials for animal husbandry.
13. Fishing net.
14. Protective garment for farmers against pesticides.
15. Textile for packaging of agro-products.

**Shade nets :**

Shade Nets are nets made of Polyethylene or Polypropylene thread with specialized UV treatment having different shade percentages. These nets provide a partially controlled environment by primarily reducing light intensity and effective heat during day time to crops grown under it. This enables lengthening of the cultivation seasons and well as off-season cultivation depending on the conditions and type of crop. Shade nets are typically used in structures known as shade net houses which are frame structures made of materials such as GI pipes, angle iron, wood or bamboo which are then covered with shade nets to provide the benefits listed above.

**Anti-bird nets :**

Enormous fatalities are caused by birds in most of the crops. The crops like grapes, guava, and pomegranate are harshly infected by parrots. From time to time the parrots can wipe out the whole crop within hours. To keep away from such huge losses, bird protection nets are used. Bird protection nets are produced from Polypropylene or High Density Polyethylene (HDPE) mono filament yarn. These yarns are ultra violet (UV) stabilized and knitted into a durable mesh fabric. Knitted monofilament nets offer effective passive protection to seeds, crops and fruit against damage caused by birds and a variety of pests. Open-mesh net fabrics are used as a means of protecting fruit plantation. The special open structure repels birds, provides minimal shading and excellent air circulation - allowing plants to flourish, whilst avoiding the risk of dangerous mould developing on the fruit.

**Windshield nets:**

Wind Shield Nets are designed for the protection of crops, small trees and plants from strong winds as well as wind-chill. They are UV stabilized in order to ensure durability and they are easy to install. There is loop line provision so that a beanpole can be used to hold the net towards the wind.

**Root ball nets/Sapling bags :**

It is extremely important for safe and speedy growing of young plants that root system is not damaged when they are dug up, transported or replanted. Normally root balls are wrapped in cloth, but elastic net tubes or Root Ball Nets are an alternative to this. When the plants are transplanted the nets on the outside do not have to be removed since the roots can protrude through the nets. Sapling Bags are a variation of this product where instead of a net a woven or non-woven bag is used.

**Anti-insect nets :**

Various insects like whitefly, thrips, aphids, etc. attack some ornamental plants and

vegetables frequently. Insect Nets are clear, woven polyethylene monofilament meshes that protect plants from insect attack (without the use of insecticides). Insect Nets can also be placed over the openings of greenhouses to prevent pollinating insects, such as bumblebees, from escaping.

#### **Mulch mats/Ground covers :**

Mulch mats are used to suppress weed growth in horticulture applications. They cover the soil around the plant or tree and help in blocking off light and preventing the competitive weed growth around seed links. This also reduces the need for herbicides required for weed control. While plastic mulch films are popular and extensively used, woven and non-woven and spun bonded agro textile mats are preferable for this application as they provide durability and better breathability.

Bio-degradable types of mulch mats based on jute are also available. In India, straw, silage, sawdust, asphalt paper, mulch film, etc. is conventionally used for mulching. However, adoption of technical textiles for mulching is yet to gain momentum, especially due to presence of cheaper mulch films.

#### **Crop covers :**

Generally, the crop covers are ultra-violet treated fabrics of polypropylene manufactured using the spun bond technique. The fabric is very tough, with a high degree of UV stabilization (to protect against breakdown in sunlight), and the suppleness makes it very easy to handle. The cover creates a micro-climate (without hindering ventilation) which gives protection against adverse weather conditions - improving both quality and yields. Crop-covers generate an outstanding micro atmosphere for seed germination and seedling growth. A crop-cover is positioned over a huge area (a number of rows) of a harvest. In cooler atmosphere, crop-covers are often positioned over direct seeded rows or newly removed crops to create a warmer, more humid micro environment to assist quick plant establishment of warm season crops. Rope covers also offer crop shelter from pesticide.

#### **Plant nets :**

These are the made from polyolefin type of fibre. It is mainly used for the tomato type of plant. The gsm of the nets are 30-40. Fruits, which grow close to the ground, can be kept away from the damp soil by allowing them to grow through vertical or tiered nets in order to keep the amount of decayed fruit to minimum.

#### **Harvesting nets :**

Harvesting nets are used to collect the fruits falling from a tree. This helps to keep the cost of cultivation low by eliminating additional labour associated with harvesting. Harvesting nets are predominantly grip structures which can be developed using warp knitting technology.

#### **Anti-hail nets :**

Hail protection fabrics help shield vines from the fruit damage and defoliation associated with hail yet still let through plenty of sunlight. The lightweight netting is tough, rip resistant,

and highly UV stabilized and has the additional benefit of protecting vines from wind and birds.

**Fishing nets :**

Fishing Nets are technical textiles utilized in fishing industry. Fishing nets are knitted fabrics used for marine and inland fishing by fisherman, fishing trawlers and boats. The characteristics and specifications of fishnets vary on the basis of method adopted for fishing. Fishnets are manufactured using nylon chips as well as HDPE. The average life of fishing nets is 2 – 3 years. Some fishermen use it after repair.

**Turf protection nets :**

A Turf Reinforcement Net is an extruded plastic mesh designed to help grass seedlings germinate and grow in a uniformly strong structure. The roots intertwine with the durable mesh and prevent separation from the soil when rolled. This allows turf producers to harvest a crop in half the time, providing the opportunity for a second planting during their season. Such nets also provide soil stabilization to make green areas available for pedestrian and vehicular use.

**Pallet net covers :**

For safe transportation of fruits and vegetables to the market individual boxes are collected into larger units and these boxes are covered with wide, large mesh nets on pallets to stop the boxes being turned upside down or squashing each other. This prevents damage to goods during transportation. Nets used for this purpose generally have high tensile strength and are made from high tenacity Polypropylene in a diamond mesh pattern and an elastic cord on the surrounding edges.

**Woven sacks/Bags :**

Woven polypropylene bags or simply woven PP bags are considered to be the toughest packaging bags, widely used to pack materials for grain, milling and sugar industry. Additionally, these bags also find wide application in fodder industry, chemicals and fertilizers industry besides cement industry and other applications like sand, metal parts and concrete etc.

**Leno bags :**

PP Leno bags are widely used for packing onions, potatoes, corn, cabbages, seafood and citrus products, etc.

**Fibres for agro textiles:**

Among synthetic fibres, polyolefin fibres are extensively used apart from small quantities of nylon, polyester fibres, whereas, jute, wool, coir, sisal, flax and hemp fibres are the representative of natural fibres. Due to their high strength, durability and other suitable properties of agricultural applications, synthetic fibres are widely used in agro tech sector. On the other hand natural fibre based agro textiles not only serve the specific purpose but also after some year degrade and act as natural fertilizers. Though manmade fibres (like

poly-olefins) are preferred for agro textiles than the natural fibres mainly due to their favourable price performance ratio, light weight with high strength and long service life, but natural fibres can be used in agrotextiles in some specific arena where characteristics like high moisture retention, wet strength, biodegradability are effectively exploited

Agro textile products where natural fibres can be used are as follows:

1. Weed management and agro-mulching.
2. Sapling bags.
3. Baler twines.
4. Bed for seed germination.
5. Packaging of agricultural products like seeds, food grains, sugar, vegetables, fertilizers, etc.

### **Natural fibres and their application in agro textiles :**

#### ***Use of jute in agricultural textiles:***

Jute agro textile is a kind of natural technical textile, usually either in woven or nonwoven form, made from 100% natural eco-friendly bast fibre of jute plant used on soil to achieve higher agricultural productivity by improving agronomical characteristics of soil and by reducing growth of unwanted vegetation.

The efficacy of jute agro textile has been established in the areas like:

- Soil conservation and reduction of nutrient loss.
- Nursery seed bed cover.
- Shade over nursery.
- Weed management and agro-mulching.
- Afforestation in semi-arid zone.
- Sleeves for growth of sapling.
- Air layering and wrapping/covering of plants.

### **Area-wise applications of jute agro textiles are given below:**

#### ***Mulch mat :***

Mulch mats are used to suppress weed growth in horticulture applications. Weed control has traditionally been achieved with bark chips, jute or black plastic (polypropylene), which cover the soil, blocking out light and preventing the competitive weed growth around seedlings. Wool and coir nonwoven fabrics are also effectively used as mulch mats.

#### **Jute sleeve for nursery use**

– For growth of seedling/sapling generally polythene bags (sleeve) are used in the nurseries. During transplantation of the grown up plants the poly sleeves are torn off and thrown away on the ground causing pollution to the environment. Moreover, the experts opine that during tearing the polythene, there is chance of damaging of some important root network of the plants. In addition, air and water circulation in the soil mass inside the polythene are also affected. Due to its inherent nature, temperature inside the sleeve sometimes goes up in tropical areas and ice formation is observed in high altitude zone, causing high degree of mortality in young plants.

– Jute based woven as well as braided sapling bags are developed by IJIRA to overcome the problems associated with poly sleeves. Due to the inherent properties of jute and the porous structure of the woven and braided sleeves air and water circulation inside the sleeve is regulated thus stimulates the plant growth.

#### **Agro bags :**

Jute has enjoyed a position of importance as packaging material since it had entered the packaging arena in 1793. Being a renewable and inexpensive natural fibre, abundantly available in Indian subcontinent, superior tensile strength and excellent frictional properties made jute the most widely accepted flexible packaging material. Agricultural commodities like grains, sugar, spices, vegetables, etc. are packed in jute bags domestically as well as globally since more than two centuries and have thus played a very important role in the national and international trade and commerce.

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#### **Use of coir in agricultural textiles :**

Coir being having the strong characteristics of retention of moisture is preferred for the agricultural applications. It is naturally resistant to rot, moulds and moisture. To suit specific applications, the coir fibre can be used as thus or by making a suitable product, which adapts the specific needs. Coir can be converted to coir yarn and then to woven mesh matting, which is used mainly controlling soil erosion and conditioning the soil. One more conversion of coir is to coir nonwoven, which is also used for controlling erosion and conditioning the soil by more ground cover and soil retention. Nonwoven coir is also used for basket liners, mulching mats, grow sticks, cultivation mats for plants, roof green application, portable lawn or instant lawn and many more applications. The coir fibre is also used for coco logs and coco beds for shore protection and stream banks.

#### **The following are the coir based products used in agriculture:**

##### ***Erosion control blankets:***

The mesh of woven coir matting acts as miniature dams and prevent the seed or seedlings, which used to be washed away by rain and wind and facilitating the growth. The netting breaks up run off from heavy rains and dissipates the energy of flowing water. Once the growth of vegetation is occurred the function of the coir is over and the vegetation will take over the protection of soil further. Nonwoven erosion blanket protects the soil from effective erosion and creating microclimates and mulching action.

##### ***Mulch blankets:***

Coir nonwoven or closely woven matting acts as a filter allowing the water to flow across its plane as well as separator. The mulch mats will suppress the weeds and retain moisture in the soil, which will protect the roots from winter frosts.

**Coir bed blankets for seed germination:**

Coir plant bed blankets are ideal for germinating seeds and have been used in applications like wetland restoration, floating islands, aquatic spawning, and even construction sediment traps. Their ability to hold a large amount of water means roots remain moist even in dry weather. As a 100% natural and biodegradable product, it offers a cost effective and environmental-friendly solution.

**Basket liners:**

Coir basket liners are used for hanging baskets. These coir pads facilitate better aeration of the growing media. Air can flow on more easily through the pores of coir pad; it will help the roots to grow faster and more vigorously. Coir nonwoven felt cut in different shapes depending upon the size of the wire basket are used as basket liners.

**Bio-rolls:**

Coir nonwoven felt mats made in the form of rolls filling it with peat moss/coir pith composite are used for bio-rolls. Rapid root growth is observed using these bio-rolls.

**Roof green mats:**

Roof greening mats are manufactured with coir nonwoven felt spread with seeds or seeds in laid with stitch bonded coir pads. These roof greening mats will spread on the roof surface and the seeds on the coir pads will sprout out and grow evenly on the surface.

**Grow sticks:**

Grow sticks are used as natural support for plant and creepers. They consist of wooden pole wrapped with the layer of coir fibre or nonwoven felt. The roots of the plant can easily penetrate on the pores of coir pad.

**Use of wool in agricultural textiles**

Wool has better insulation properties under moist condition than polypropylene/polyethylene and can prevent seedling damage from ground frost thus enabling earlier sowing and a longer growing season. The wool keeps the soil temperature constant and compared with black plastic, does not give a wind tunnel effect, which dries out the soil.

**Mulch mats:**

Needle punched nonwoven wool is used for mulch mats. The wool fibre biodegrades over a one to five year period and gets incorporated into the soil as fertilizer/conditioner for the next crop. Further, wool mulch mats allow water to enter in to the soil (unlike black plastic), and also act as a barrier to prevent excessive soil desiccation during dry period.

**Other natural fibres :**

Sisal and Hemp fibre based baler twines are used in grape yards for tying. These twines are strong thread composed of two or three smaller threads or strands twisted together and mainly used for crop wrapping. This is also used in tomato plantations and can also be

used for all heavy fruit and vegetable plantations to hold it on its stem or branch.

### **Conclusion :**

From this paper it can be concluded that, the potential of the usage of natural fibre agro textiles is really huge. Indian market potential for such end use is relatively huge as the country is blessed with large production of natural fibres. Public awareness is also growing in the use of natural materials. Overall agro tech is gaining attention among the users and this particular field in which, the growth was modes

### **REFERENCES**

- Basu, S.K. (2011). Agricultural and horticultural applications of agro textiles. *Indian Textile J.*, **121** (12): 141-148.
- Chakrabarti, Ruma, Gowri, K. and Senthil Kumar, R. (2011). Agro Textiles - A Review, Fibre2Fashion, January 17, 2011, URL: <http://www.fibre2fashion.com/industry-article/32/3158/agro-textiles-a-review1.asp>.
- Choudhury, P.K. Jute Agrotexiles - its Properties and Applications, Indian Jute Industries' Research Association, 17 Taratala Road, Kolkata 700 088, URL: [www.jute.org/Documents\\_Seminar.../JAT\\_IJIRA\\_KK\\_06-05-10.pdf](http://www.jute.org/Documents_Seminar.../JAT_IJIRA_KK_06-05-10.pdf)
- David, Pimentel, Xuewen Huang, Ana Cordova, and Marcia Pimentel (1996). Impact of Population Growth on Food Supplies and Environment, Presented at AAAS Annual Meeting, Baltimore, MD, 9 February 1996, URL:<http://dieoff.org/page57.htm>.
- <http://www.technicaltextile.net/agro-textiles/baler-twine/supplier.aspx>.
- International Year of Natural Fibres (2009). Food and Agriculture Organization of the United Nations Viale delle Terme di Caracalla 00153 Rome, Italy. URL: <http://maa.missouri.edu/pdfs/yearnaturalfibres.pdf>.
- Mussig, Jorg and Stevens, Christian (2012). Industrial Applications of Natural Fibres: Structure, Properties and Technical Applications, Wiley.
- Palash, Paul and Debiprasad, Gon (2011). Coir fibre and its application in geotextiles. *Indian Textile J.*, **121** (6) : 61-67.
- Palash, Paul and Partha, Sanyal (2012). Scopes of vegetable fibres in technical textiles sector, Souvenir of Institute of Jute Technology Re-Union 2012, pp 66 - 70, January 2012.
- Pillai, M. Sudhakaran and Vasudev, R. (2001). Applications of Coir in Agricultural Textiles, International Seminar on Technical Textiles, Mumbai, India, 2-3 June 2001, URL: [www.ccriindia.org/pdf/agritex.pdf](http://www.ccriindia.org/pdf/agritex.pdf).
- Sankhe, Manoj and Chitnis, R.S. (2002). Textile structures and their application in agriculture. *Indian Textile J.*, Vol **CXIII** (3) December (2002).
- Study on developing measures to promote the use of agro textiles in India under the technology mission on technical textiles (TMTT) December 2013, Ministry of Textiles, GOI.
- Subramaniam, V., Poongodi, G.R. and Sindhuja, V. Veena (2009). Agro-textiles: Production, properties and potential, *Indian Textile J.*, **119** (7) : 73-77.

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