

Textiles for smart farming

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Abstract: Food is the prime necessity for every living being. This necessity is met through a variety of ways viz. farming, fishing and dairy products. Amongst these, farming forms the major source as it includes wheat, rice, fruits, and cereals etc. It is well known that farming use a large portion of land. However, the land required for cultivation is decreasing with time as on an average 83 million people are added every year at the rate of around 1.08% per year over the world. Thus to provide food for everyone using conventional agriculture methods is becoming a Herculean task with time. There is a need felt to preserve the cultivated products, to reduce the wastage and to develop some advanced technologies requiring less space, less water and no harmful chemicals (preservatives, fertilizers etc). Textile peoples have joined hands with peoples of agricultural field to improve the conventional methods and to protect the vegetables, fruits etc by developing a number of sophisticated products. This paper discusses the details of such agrotech products that provide controlled environment with better productivity.

Keywords: Agrotexiles, Horticulture, Plant nets and Fruit nets.

1. Introduction

Agriculture is the backbone of the world economy as it provides one of the basic amenities of life i.e. food. The demand for food grains is increasing day by day due to increasing population of the world. In India itself it is expected to be around 280 million tons by 2020. On the other hand, per capita availability of cultivable land is reducing that makes it important to search for additional resources or increase the yield per acre of land. However it is not possible to increase the yield and to produce quality products by adopting traditional ways due to various regional and seasonal limitations of cultivation. Textiles can effectively be used solely or in combination with other techniques to provide controlled environment for better agricultural growth which is originally limited by the natural environmental factors like temperature, humidity, wind speed and exposure to sunlight etc. Apart from these environmental factors textiles can be effectively used to protect the agro products from birds, hails, wind, rain and pests etc. hence also reducing dependency upon harmful chemicals used for pest controls and higher productivity. Textiles are also used extensively in more innovative techniques of farming such as vertical farming by which higher production can be realised on small area of land. The global agro textiles market size was valued at USD 8.46 billion in 2016 which is expected to reach USD 12.77 billion by 2025 [1,10].

2. Need of agro-textiles

Agro-textiles are required to prevent soil from drying out, to increase crop yield, save energy in field as possible as, prevents staining and improves product quality, thermal protection to farm and farmer too, prevent insect contact with food or crop, reduce workers and work load, to improve yield quality and to protect the farmers from harmful pesticides and also for artificial land [2].

3. Classification

Agro textiles can be classified in to two ways:

3.1 On the basis of manufacturing technique

Woven, Non-woven, knitted, nets, sheets and coated composites [2].

3.2 On the basis of areas of application

- Agro textiles for crop production
 - Agro textiles for horticulture, floriculture
 - Agro textiles for animal husbandry and aqua culture
 - Agro textiles for agro packaging related application [2, 3].
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4. Properties required

The products of Agro-textiles should be resistant to solar radiations, micro-organisms, UV radiations and should be light weight, easy to transport, weather resistant and stable [1,4].

5. Fibres used

Both natural and synthetic fibers are used for agriculture textiles. Natural fibers based textiles not only serve the specific purpose but also degrade after some year and act as natural fertilizer. Wool, jute, coir, sisal flax and hemp are used due to their high strength and durability. Polyolefin, nylon, polyester, polyethylene & polypropylene fibers are used as synthetic fibers [5].

6. Applications of Agro textiles

6.1 Mulch mats

It is made of natural fibers wool, jute or HDPE in the form of woven, non-woven and mulch films. Mulch mats are used for tea, strawberry and plants grown in hilly places It covers the soil surface around the plant so as to create congenial conditions for plant growth. It maintains the moisture, salinity, temperature and also controls the weeds. It increases the speed of growth, yield and quality of crop [2,7].



Figure-1
Mulch Mats

6.2 Anti-hail nets

These are made from HDPE yarn or a combination of HDPE monofilament and tape in knitted form. Hole sizes provided to receive minimum level of shade. These nets are used on each individual tree to the protect crops like apple, litchi etc. from hails in hail prone areas and high altitude areas [6, 7].



Figure 2- Anti –hail nets

6.3 Bird protection nets

Nets are mainly made by strong yarn so that birds cannot damage and mainly made from polypropylene or HDPE yarn. This net structure with small opening does not allow the birds to damage the fruits but keep the sufficient opening for movement of bees. Generally used for grapes, guava and pomegranate. These are used for banana, grapes, guava, pomegranate and mango [6].



Figure 3 - Bird protection nets

Now a days non-woven made of polypropylene are also used to cover the fruits which keep the black dots away, gives a good shine and also helps in early harvesting of fruits [3, 7].

6.4 Crop covers

Covers may be woven, non-woven or in sheet form generally made up of polypropylene and light in weight·



Figure 4 (a)-Crop Covers



Figure 4(b) - Crop Covers

They are used for covering the crops to control weed growth, provide microenvironment for seed germination and retain moisture in the soil. Also provide protection against rain, frost, hail, wind and insects. There is early harvesting by 2-3 weeks. Mainly used for cabbage and other leafy vegetables, potato and cucumber [5, 7].

6.5 Wind shield



It is made up of HDPE by weaving technology. They are used for protecting the sensitive plants from the impact of high speed winds. This reduces the damage to the plant and increases yield. Size of the fabric used depends on size of the plant [9].

Figure 5 - Wind screen

6.6 Root ball nets



Net like structures are used for safe and speedy growing of young plants such that root system is not damaged when they are dug up, transported or replanted [1].

Figure 6- Root ball nets

Normally the root balls are wrapped in cloth. Elastic net tubes are 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. These structures are made of polymers and they can change their shape accordingly and the gap between the net allows the water to pass through [7, 11].

Figure 7 Insect meshes



These are made from the polyethylene or fibre glass which keeps out harmful insects from entering green houses and tunnels and also keep pollinating insects inside. Mesh material to be strong enough for insects to be not able to destroy it [7].

Figure 8- Insect meshes

6.8 Agro-bags



An Agro bag facilitates transplantation and accelerates the resumption of growth of a plant [7].

Figure 9- Agro-bags

6.9 Packing material



Polyethylene and poly-vinyl chlorides are used for making packing material. Packing materials are used for packaging of different fruits and vegetables. These materials are useful because of their high strength, low weight, transparency, air permeability and low cost. The pressure exerted on soft fruits is very less, which reduces the damage to such items in transportation [9].

Figure 10- Packing materials

6.10. Fishing nets



Fishing nets are the knitted fabrics used for marine and inland fishing and fishing trawlers. These nets are made of nylon chips and HDPE [5].

Figure 11- Fishing nets

These have high tensile strength, breaking strength and abrasion resistance. They can be used to catch the wide variety of fishes [5,7].

6.11. Shade nets

Shade nets are made of PE or PP with special UV treatment with different shade percentages [5].



Figure 12- Shade nets

These nets provide a partially controlled environment by reducing light intensity and effective heat during day time to crops grown under it.

These are used for nurseries of fruits and vegetables and protect the crops from weather conditions like hails, storm, frost, wind insect bird and snow [5, 7].

6.12 Vertical Farming

Vertical farming is the modern technology of farming where crops are grown inside the skyscraper without use of soil. The modern ideas of vertical farming use indoor farming techniques and controlled-environment agriculture technology, where all environmental factors can be controlled [9]. These facilities utilize artificial control of light, and environmental control (humidity, temperature, gases).

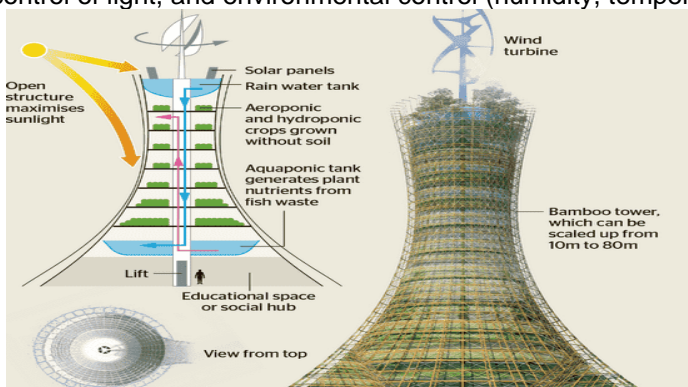


Figure 13- Vertical farming

Agrotexiles used in this field plays vital role in improving yield and production in vertical farming. This skyscraper made up of glass or polycarbonate sheets which allow sunlight inside and avoid harmful rays to enter in farm. Structure of skyscraper is either of bamboo sticks or steel material. Inside the farm there are steps where nonwoven materials are used instead of soil. Use of nonwoven instead of soil is the most innovative idea comes in agriculture. Use of this method provides good circulation of air, sufficient amount of water due to absorbent fibers and no requirement of herbicides or pesticides.

6.13 Plantagon

Plantagon is the next generation of vertical farming. In vertical farming is unable to get sunlight at the middle of steps crops. Plantagon has circular shapes which provide sunlight to each and every plant. In this system soil is not used PUMICE is used mainly because it has a beneficial capillary effect and can be used for several years within the greenhouse system. Pumice is a volcanic rock and the result from the cooling of volcanic lava in water. It has good air porosity that can absorb nutrients. Glass material used on plantagon is uv protected. According to growth cycle of plant logistic system is developed. Other packaging textiles are

used for packing and transferring agro product. Use of nonwoven sheet as a soil reduce use of weed control net or mulch net too [9,10].

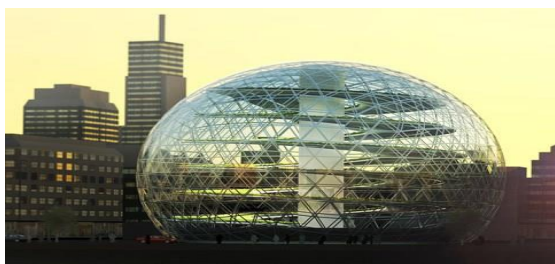


Figure 14- Agro textile used in Plantagon

7. Conclusion

The study shows the applicability of textile products for the sustainable development of agriculture by providing controlled environment for better plant growth, better protection and packaging to the agriculture produce along with development of new technologies such as vertical farming. Hence agro-textile shows a great market potential in near future and still needs to explore some new ideas.

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