Fabric of the Future: Agrotextiles Empowering Smart Agriculture

Sanchana Dhas A. K[1]*, Ramadass S[2], Saravana Kumar M[3] and Priyanjena Chacko J[1]

[1]PG Scholar, Dept. of Agronomy, SRMCAS, SRMIST, Chengalpattu-603201.
[2]Assistant Professor and Head, Dept. of Agronomy, SRMCAS, SRMIST, Chengalpattu-603201.
[3]Assistant Professor, Dept. of Agronomy, SRMCAS, SRMIST, Chengalpattu-603201.

Corresponding Author
Sanchana Dhas A.K.
Email: sa0135@srmist.edu.in

OPEN ACCESS

Keywords

Agrotextiles, Smart agriculture, Sustainable farming, Natural fibres, Crop protection, Resource conservation.

How to cite this article:

Dhas, A. K. S., Ramadass, S., Kumar, M. S. and Chacko, J. P. 2025. Fabric of the Future: Agrotextiles Empowering Smart Agriculture. *Vigyan Varta* 6 (11): 104-107.

ABSTRACT

Agriculture, the backbone of human civilization, is now transitioning towards sustainability through innovative technologies. Among these, *agrotextiles* have emerged as a vital component of smart agriculture. Agrotextiles refer to specially designed woven, non-woven, or knitted fabrics applied in agriculture, horticulture, and related sectors to enhance productivity, conserve resources, and protect crops. These materials play a crucial role in moderating environmental conditions, controlling pests and weeds, conserving soil moisture, and reducing dependency on chemical inputs. Common applications include shade nets, anti-bird nets, insect nets, mulch mats, and windshield nets—all contributing to improved crop quality and yield. The use of both synthetic fibres (polypropylene, polyester, nylon) and natural fibres (jute, coir, wool) allows for a balance between durability and sustainability. With the integration of eco-friendly materials and advanced textile engineering, agrotextiles are paving the way for climate-resilient and sustainable farming systems.

INTRODUCTION

Agriculture is being the most primary occupation of mankind and is still a major industry. As there is variation in the climate and huge stress on the production of agricultural crops, there is a quest for sustainable food system which intensifies agriculture in entering a new era where innovations are weaving new technology into the fabric of the fields, which transforms old age farming into future ready sustainable ecosystem. One such innovation used is agrotextiles a special class of textiles which is designed to support and ensure agricultural practices. It is an integration of agronomic techniques in which agrotextiles offer tools for increasing crop yield, protecting the environment and resource conservation. By fusing with traditional agronomic practices, agrotextiles enable the way for efficient, resilience and eco-friendly farming.

What are Agrotextiles?

Agrotextiles are defined as the technical textiles that is designed particularly used in agriculture, horticulture, forestry and aquaculture. Agrotextiles involves all the textiles products meant for agriculture production with direct incorporation in the agro-technical practice. "Agrotextiles" classifies the nonwoven, woven and knitted fabrics which is being applied for agricultural and horticultural to use covering livestock protection, weed, insect control extension of growing season and shading including agri-produced packaging. Therefore, agrotextiles are termed as "Farm to Folk" products.

Need for Agro-textiles:

Cultivation has been expanding to suit the world's food needs. Food insecurity still affects more than 800 million people, and the number is growing. Agriculture is further threatened by climate change, intense competition for land and water, rising energy costs, and ecological degradation. Agrotextiles shield fruits from hail and assist maintain an adequate level of soil humidity and temperature. These days, organic foods are popular because of the rising number of ailments brought on by chemicals in fruits, vegetables, and other meals. These activities are made possible by compost, sheltered sunlight, and the use of agrotextiles, which effectively regulate water (Bhavani *et al*., 2017). By keeping the soil from drying out, these agro textiles boost crop productivity. UV radiation stabilizers are commonly used in thermal protection fabrics. Thermal screens and shade netting are well-known equipment that can reduce heating energy consumption in greenhouses by up to 40%. Utilizing these nets enhances the uniformity of colour, reduces discoloration, and improves the quality of fruits and vegetables.

Application of Agro-textiles:

Technical textiles known as agrotextiles are made especially for use in agriculture to boost output, safeguard crops, and encourage environmentally friendly farming methods. They are used for a variety of purposes, such as protecting crops from pests, birds, and harsh weather; controlling soil erosion; controlling weeds; conserving water; and creating controlled conditions in greenhouses. Shade nets, mulch mats, insect nets, and ground covers are examples of common agrotextiles that help increase crop output, lower chemical use, and preserve natural resources. Agrotextiles are essential to contemporary agricultural systems because of their adaptability and potential for environmental sustainability.

Shade nets:

Shade nets are nets with varying degrees of shade that are composed of polyethylene or polypropylene thread and specially treated with UV light. These nets offer a somewhat regulated environment by mainly decreasing the amount of light and heat that crops growing beneath it receive during the day. Depending on the crop type, it allows for both off-season and cultivation seasons. Shade nets are frame buildings composed of bamboo, angle iron, wood, or GI pipes that are covered in shade nets to offer the aforementioned advantages.

Anti-bird nets:

Anti-bird nets are used to stop birds from causing large crop losses, particularly in fruits like pomegranates, guavas, and grapes, which are frequently harmed by parrots. UV-stabilized polypropylene or HDPE monofilament yarn is knitted into a sturdy mesh fabric to create these nets. The open-mesh design efficiently shields crops while permitting sunshine and air flow, lowering the possibility of mould growth and encouraging robust plant development.

Windshield nets:

These nets are made to protect plants, small trees, and crops from high winds and cold temperatures. They are UV treated to guarantee longevity and installing them is simple. Loop lines are provided so that the net can be held into the wind with a beanpole.

Anti-insect nets:

Some of the insects like Thrips, whiteflies and aphids prey on plants. Bug nets, made from transparent woven polyethylene monofilament, protect plants from insect infestations, reducing the need for chemical pesticides. Additionally, to keep pollinating insects like bumblebees from fleeing, bug nets can be positioned above greenhouse openings.

Mulch nets:

By preventing sunlight from reaching plants, mulch mats are used in horticulture to inhibit the growth of weeds and lessen the demand for herbicides. Despite the widespread use of plastic mulch films, woven, non-woven, and spun-bonded agrotextile mats provide superior breathability and durability (Sharma *et al.,* 2022). There are also biodegradable alternatives, such as mats made of jute. Because traditional materials are less expensive, technical textile mulch mats have not yet gain ed widespread adoption in India, despite their advantages.

Harvesting nets:

Using a harvesting net, one can gather the fruits that fall from trees. This removes the need for extra labour related to harvesting, which lowers the cost of cultivation. Acquiring nets can be mad e

utilizing warp knitting technology, which is primarily used for grip construction

Fibres For Agro-textiles:

Agro-textiles are strong, durable, lightweight, and reasonably priced, synthetic fibres such as polyester, nylon, and polyolefins are frequently employed in agrotextiles. Natural fibres including hemp, flax, jute, coir, and wool are also utilized, particularly in situations where soil enrichment, moisture retention, and biodegradability are sought (Dorugade *et al*., 2023). Although synthetics are preferred for their extended lifespan and functionality, natural fibres are best suited for some uses that demand environmental friendliness and decomposition advantages.

The use of natural fibres in agricultural textiles:

Jute:

One type of natural technological textile is jute agro textile, which is often woven or nonwoven. Jute, created from the jute plant's 100% natural, environmentally beneficial bast fibre, is applied to soil to increase agricultural output by enhancing the soil's agronomic qualities and inhibiting the growth of undesired vegetation.

Wool:

An extended growth season and earlier sowing are made possible by wool's superior insulating qualities in damp conditions compared to polypropylene/polyethylene. Additionally, wool can shield seedlings from ground frost damage (In order to prevent excessive soil desiccation during dry periods, mulch mats made of needle-punched nonwoven wool serve as a barrier and let water into the soil.

CONCLUSION:

Agrotextiles are essential to modern agriculture because they enhance crop productivity, shield plants from pests and inclement weather, conserve resources, and support sustainable agricultural methods. Agrotextiles have wide range of tools that enhances crop quality, yield and farm productivity. There is a bright future for sustainable agricultural development as agrotextiles, especially eco-friendly natural fibre choices, are predicted to become more widely used as awareness rises and technology develops.

REFERENCES:

Bhavani, K., Mallikarjun, N., & Sunilkumar, N. M. (2017). Agro textiles-Their applications in agriculture and scope for utilizing natural fibers in agro tech sector. *International Journal of Applied Home Science*, *4*(7), 653-662.

Dorugade, V., Taye, M., Qureshi, S. A., Agazie, T., Seyoum, B., Abebe, B., & Komarabathina, S. (2023). Agrotextiles: important characteristics of fibres and their applications–a review. *Journal of Natural Fibers*, *20*(2), 2211290.

Sharma, N., Allardyce, B., Rajkhowa, R., Adholeya, A., & Agrawal, R. (2022). A substantial role of agro-textiles in agricultural applications. *Frontiers in Plant Science*, *13*, 895740.