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Novel Aspects of Cotton, Fiber Production in Agriculture and Importance as Staple Crop

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Abstract

Cotton belongs family Malvaceae, genus hirsutum and tribe Gossypiae, and it is usually divided in to two types: the wild and the cultivated cotton. To understand the molecular base of the plant reactions to main abiotic stresses like salinity and drought is important for bio-technological applications of stresses adaptations for crop development. In this perspective, thousands of stress receptive genes are recognized and a small number of them are characterized functionally. Thrilling temperatures, salinity and the water reduction are major abiotic stresses which are reflected the primary issues, which reduces the cotton production. The global drop of cotton crop is fifty percent due to abiotic stresses or supreme cotton crop yield; they need optimal growth situations like the other field crops. Due to drought stress response, boll of cotton plant and its leaf area is reduced and any change in carbon uptake also put its impact on photosynthesis. Polyphenolic with capable contraceptive reactions, a gossypol and terpenoids with anti-inflammatory effects and cytotoxic activities of trans-caryophyllene are some examples of potential chemical compounds present in cotton with their valuable impacts on humans and animals health as well. . Cotton seeds are now inspected as most potential co-product and a high valuable part of cotton processing chain and it is most viewed left over by product of cotton.

Keywords: Biotic, abiotic stresses, economical importance, stress biology, crop cultivation.

INTRODUCTION

Gossypium hirsutum L. (cotton) belongs family Malvaceae, genus hirsutum and tribe Gossypiae, and it is usually divided into two types: the wild and the cultivated cotton. There are fifty species of cotton which are known and only four are cultivated [1, 2]. The two species (G. herbaceum and G. arboreum) are diploid species, and the other two (G. barbadense and G. hirsutum) are the tetraploid. Above 80 percent of world cotton area is cultivated by the tetraploids species. Though, diploid species are grown in Middle East and in Asia [3-5].

Currently the cotton is world leading fiber crop and it is commercially cultivated in tropical and temperate territories of above fifty countries, with cultivated area of 34 M hectare [6]. The 4 most grown species of cotton are G. arboreum, G. hirsutum, G. barbadense, and G. herbaceum. These cotton species are from each other for quality, length, strength, maturity and cell wall thickness or micronaire of fiber. The variations in the quality of fiber, fiber yield and adaptation to definite conditions of climate, has contribute to liking of some species of cotton over the other species. All 4 cultivated species of cotton are utilized in many other purposes, like production of food and in medicinal purposes [7-9].

The seed coat of cotton seed lengthens in to tubule fiber and is spun in to the yarn. Particular parts of cultivation includes the countries like India, USA, China, Australia and Middle East, in these countries climate situations suit the growth necessities of the cotton species, with periods of dry and hot weathers, and where the suitable moisture is existing, frequently obtained by the irrigation[10]. Between five main cotton cultivating states, China is the major producer of cotton and produced 1,265 kg/ha, then USA 985 kg/ha, then Uzbekistan 831 kg/ha, Pakistan produced 599 kg/ha and India produced 560 kg/ha. India stand 1st in area cultivation, cultivated over the quarter of world area of cotton, then China, USA, and the Pakistan. Around 26.247 million metric tonns of cotton is produced worldwide [11].

Fig-1: Shows the morphology of cotton as most cultivated crop

One most outstanding story in archives of domestication of crops is foundation of urbane cotton. Maybe the most conspicuous feature of this antiquity is that it is universal in choice, linking antique humanoid principles in both New and Old Spheres and a convergent plant taming procedure from the divergent and geologically remote wild descendants [12]. Certainly, cotton is the unique between crop plants in that 4 distinct species were autonomously domesticate for the particular single celled trichomes, or yarns, that arise on epidermis of seeds [13].

Some of them are projected as appropriate target for genetic engineering in edict to reduce stress lenience in the plants. Among many genes examined, the transcriptional factors are reflected to be right targets for learning the molecular techniques of abiotic stresses responses as they singularly or in conjunction control the manifestation of numerous downstream target genes [14].

Amid the numerous transcriptional factors programming genes, home-box gene that is well-known to be intricate in varied features of growth, lately been associated in abiotic stresses response [15]. Through the several over expressions and transmuted investigations, the flexibility of home-box genes in the plant has been exposed. Abiotic stresses are the main warning factors which disturb the yield, growth and the cotton development. Cotton is a fiber crop. Cotton is grown in several states across the world. Cloth home material and the medicinal products are formed from the cotton. The raw materials for fabric industries and also the consumption of oil which is used in homes is fulfilled by the cotton crop [16]. Thrilling temperatures, salinity and the water reduction are major abiotic stresses which are reflected the primary issues, which reduces the cotton production. Plants patience to higher temperatures in altering environments: scientific essentials and heat stress tolerant crops production [17].

The global drop of cotton crop is fifty percent due to abiotic stresses or supreme cotton crop yield, they need optimal growth situations like the other field crops. For instance, a temperature of 27 to 32°C is favored by cotton during boll formation. At ≥36°C, the foremost decrease in carbon fixation was noted in this crop, and for optimal photosynthesis, the optimal temperature is ~33°C. Reduced growth and yield of plant are affected by main influence of alkalinity and salinity. The water stress in this crop is affected by salt act as an osmotic[18].

Low yield during crop production, is a major problem that is caused mainly by specific ion toxicity and imbalance supply of nutrients at specific intervals of time. During high temperature management practices, plant metabolism is greatly affected by impaired photosynthetic processes and membrane thermo-stability. Denaturation of proteins and activity of enzymes are more sensitive to high temperatures. Decrease in turgor pressure directly influenced on cell growth, carbohydrate metabolism and photosynthesis during drought stress in cotton plants [19].

Any change in carbon uptake also changes the process of photosynthesis resulting in the decrease of boll maintenance of the cotton plant and also the area of leaf that is a response to the stress due to drought. Due to drought stress response, boll of cotton plant and its leaf area is reduced and any change in carbon uptake also put its impact on photosynthesis [20].

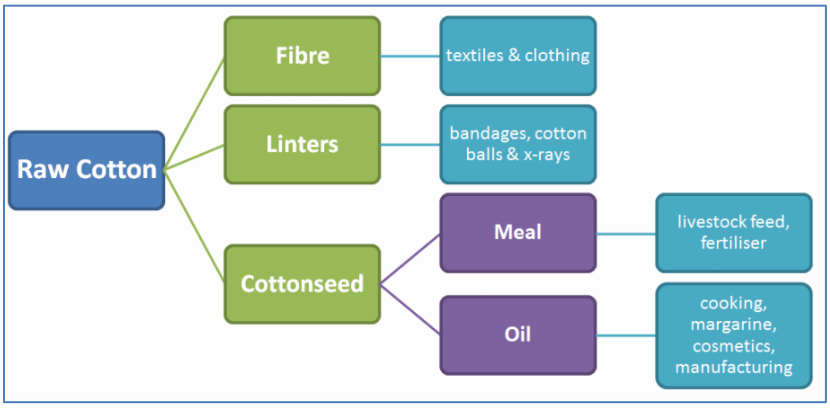

Fig-2: Shows the raw cotton and its product, byproducts

Different abiotic stresses affect the yield, growth and fiber quality of cotton crop. In this chapter, we have discussed the impacts of different abiotic stresses on cotton performance and have enlisted possible improvement in its performance through application of plant hormones (auxin, cytokinins, abscisic acid, brassinosteroids, ethylene, and gibberellins) and plant nutrients (macronutrients and micronutrients). Fatty acids, proteins, carbohydrates, lipids, terpenes and phenolics are naturally occurring major compounds and cotton plant has potential to providing all these in valuable amount. Leaves, stems, roots, seeds, calyx, bolls and stalks are main organs of cotton that provide all these compounds and these parts also perform biological functions in animals and humans[21-23].

Polyphenolic with capable contraceptive reactions, a gossypol and terpenoids with anti-inflammatory effects and cytotoxic activities of trans-caryophyllene are some examples of potential chemical compounds present in cotton with their valuable impacts on humans and animals health as well. Cotton gin trash (CHT), post-harvest trash (PHT) and crushed seeds are the main by-products produced by cotton industry [24]. For recycling and reducing left over organic wastes in environment, agricultural products and by-products except cotton plant crop have been used for energy and material generation. For this purpose, rice, sugar cane and soybean are agricultural by products that are currently used [25]. Important chemical extracts that are potential resources from agricultural biomass have not been completely used. Now these potential chemical compounds has gained a little attention from cotton by-products. Hence, it's logical use will be more beneficial to cotton industry and for local environment. A comprehensive interrogation is required to provide quick reply to such kind of questions: in these agricultural cotton by-products, what kind of extracts are present; how these chemical profiles are variable among cotton species and varieties and what kind of these left over by products have high valuable compounds[26].

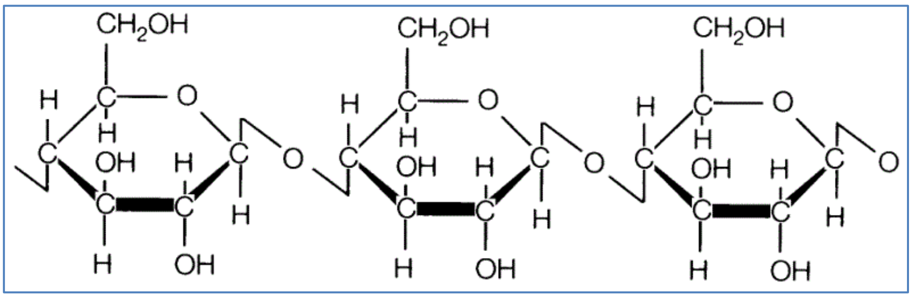

Fig-3: Shows the chemical stature of the cotton fibre

That's why, for this purpose, a smart overview of cotton production begins with its industrial waste and latest usage. Different compounds play different roles in cotton plants during metabolism and when plants interacted with environmental conditions. Carbohydrates, proteins, fats, fatty acids etc. all are naturally occurring and distributed variably in specific parts of plant with different concentrations and these chemicals distributed according to their particular functions[27].Cotton seeds contain about 55 percent ginned cotton by weight, cotton fiber (35% to 40%) cotton gin trash (CGT) with 10% only. Cotton seeds are now inspected as most potential co-product and a high valuable part of cotton processing chain and it is most viewed left over by product of cotton [28-30].

CONLCUSION

With updated practices in feed and food industries, cotton seed is selected as high value protein meals and oils while cotton gin trash (CGT) is observed as low quality waste with negligible potential. CGT with practicable nutritional profile consists of calcium with 11%, 12% crude protein, 90 percent dry matter, 47 % digestible nutrients has been proved in contributing best health of livestock. It also contains some unused chemicals that used during agricultural practices and also used as fertilizer supplement that conserve composition and soil moisture. Silica and fulvic acid have also been processed by by-products of cotton industry.

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