

# Creating Finely Fibred Non-Gossypol Organic Cotton

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## Abstract

Data are provided on a group of breeders from the Bukhara Scientific Experimental Station (under the leadership of A. Battalov and others), who bred (in 1975-2019), cotton large-bolls (8-9g), fine-fibred, silver-glossy color. Resistant to extreme conditions, giving high-yielding, high-quality, organic cotton (Bukhara - 9/1-I), in conditions of saline, arid soils, the Republic of Uzbekistan.

Their morphophysiological features, economically valuable traits, history of creation, crossing methods, role, significance of the bred new variety for humans, animals, medicine, and environmental ecology are described. Noteworthy are a number of hybrids for creating new varieties that are not available in all organs of the gossypols, about its applicability as a donor, and its use in crosses.

The variety is the only one in the world that is environmentally friendly, early ripening, resistant to pests and abiotic stresses, convenient for machine harvesting. Does not contain gossypol in both vegetative and generative organs.

Organs and seed kernels can be used to obtain environmentally friendly vegetable oils, protein flour and cotton waste, which can be used to prepare natural, safe, clean products for poultry, livestock and fisheries. In medicine, it is possible to produce various biologically active substances, drugs. With a 45% reduction in costs, profitability increases.

**Keywords:** organic cotton; without gossy full grade bukhara-9/1-I; fine-fibred; silver-white color of the fiber; eco-products; stress and pest resistance

## Introduction

When laying the foundations of the Third Renaissance of new Uzbekistan, one of the urgent tasks today is to educate the future generation, make it comprehensively developed, healthy, knowledgeable, provide it with the appropriate needs for nutritious, safe food, clothing, manufactured goods, high-quality organic fiber and eco products [1,2]; [4,5,11]; [13,17]. Today, our cotton growers are faced with the task of satisfying not only the need of our people for high-quality fiber, but also for vegetable oil, nutritious protein and other natural, environmentally friendly products [1,2]; [4,5,11]; [13,14]; [15-17].

## Literature review

In the 60s of the last century, in foreign countries (USA, China, Israel, etc.) and in Uzbekistan, several attempts were made to create organic non-state cotton varieties. However, the gossypolous varieties they

created were very weak, low-yielding, and susceptible to diseases. Therefore, foreign and our domestic breeders working in this area, due to the lack of positive results, stopped their scientific work [3, 6]. For the first time in 1954, among US scientists, Mc. Michail isolated forms of cotton without gossypol glands in seeds and leaves. Bottger et al. (1964) note that this variety is not resistant to various pests and has a low yield. In 1967, American scientists first developed without gossypol varieties "Gregg-25" and then "GZ-16". Varuntsyan I.S. (1970) described in his papers on the development of without gossypol cultivars in the UAE, the so-called cultivar Bakhtim-110 belonging to the species *G. Barbadosense* [6]. Later such scientists as: S. Rakhmonkulov, Sh. Namazov, R. Yuldasheva [3, 6], T. Rakhimov, Sh. Namazov, I. Amanturdiyev R. Yuldasheva [7-9], [10,12] and others wrote scientific articles and materials in journals on the creation of gossypol (+) varieties and its role in the life of cotton in Uzbekistan and abroad. The varieties created by them did not

have gossypol in the seeds, and gossypol existed in the vegetative organs, other articles dealt with the effect of gossypol on the cotton bollworm, seed germination, etc[7-9], [10,12]. The great breeder of the Research Institute of Selection, Seed Growing and Agricultural Technology of Cotton Growing of the Bukhara Scientific Experimental Station A. Battalov and his students, overcoming various difficulties, failures and obstacles, worked tirelessly for the great goal until 1977-1998 to create a non-gossypolny medium staple cotton variety.

As a result of multiple crossing of hybrids and testing of offspring, with the help of individual selection, studies conducted in 1998-2006, new promising environmentally friendly medium fiber lines with stable valuable economic and quality indicators, not containing toxic alkaloids - gossypol in the vegetative and generative organs, were obtained. Initially, significant groups of gossysexual lines were obtained. They were divided into little-gossypol and non-gossypol lineages. They differed by morphobiological, economically valuable traits and technological indicators of cotton into several groups. They were tested for resistance to diseases, for stressful environmental conditions. High-yielding, early-ripening, improved lines that meet international standards have been identified, from which all economically valuable and technologist-qualitative features have been selected. The most optimal lines in terms of quality stood out L-20. This line was one of the first swallows that did not have gossypol cotton from medium fiber varieties in all organs [1,2], [4,5]. [11,13].

After the death of A. Battalov, scientists of the Research Institute of Selection, Seed Production and Agricultural Technology of Cotton Growing of the Bukhara Research and Experimental Station continued breeding work by interspecific crossing [(Bukhara-6 x Collection non-gossypolny number) x Bukhara-9] and re-hybridization, the lines were crossed and purposefully selected. As a result of repeated individual selections and checks, a new fine-fiber organic cotton was isolated that does not contain gossypol in the vegetative and generative organ. The grade has fiber type I-II, it is very convenient for machine harvesting. The weight of one box is 4-6 g heavier than the standard, fine-fiber variety. Bolls are 5-lobed, with a silvery-white color, high-yielding, early ripening, environmentally friendly [13]. Breeders of the Bukhara Scientific Experimental Station are trying to solve the problem in a positive way by

creating an export-oriented, import-substituting cotton-producing organic cotton variety that does not have gossypol in all organs of the cotton plant. It meets the requirements of the world market: low cost, high yield and fine fiber quality, environmentally friendly protein flour and edible oil. The weight of 1000 pieces of seeds is higher than standard varieties. A new variety is promising, which even under extreme conditions gives a high yield compared to standard varieties. Until now, the presence of the gossypol alkaloid, which is harmful to human and animal health, in vegetable oil obtained from the seeds of cotton varieties in the cotton industry, prevents the production of environmentally friendly products. To turn technical oil into food, the seed kernel is processed.

The peoples of Central Asia like to eat oil obtained from cotton seeds. When processing technical oil into consumer oil, 45% of the costs are spent. The extraction and purification of this technical oil from toxic alkaloids increases the cost of production. And from new non-gossypol varieties of cotton, consumer organic oil is obtained by cold pressing without processed products. At the same time, additional costs are not used - labor, working hours, electricity, acid, gasoline, etc., the cost of production is reduced, valuable environmentally friendly eco-products and fine fiber are grown. Indeed, it is necessary to carry out constant selection research in the field of production, to develop new environmentally friendly, industrial, early-ripening, high-yielding cotton varieties that are resistant to adverse environmental conditions and pests, producing environmentally friendly vegetable oils, protein flour, and valuable fine fibers. And it is necessary to replace it with low-yielding technical varieties of gossypol cotton, which have more advantages over them, which are currently very relevant. Among these lines, a new type of non-gossypol varieties of cotton has been created, having I and II types of fiber, large bolls, silver-shiny white fiber, early ripening, with high qualities, meeting all the requirements of the international market. The scientific novelty of the study lies in the fact that in the presence of fine-fiber varieties of cotton grown in our country and the world, which have the poisonous substance gossypol in all organs, and in a new variety of silk cotton, the absence of gossypol (vegetative and generative organs) and the mass of one cotton boll (4-6 gr.) is heavier, in technical fine-staple varieties of cotton it has 5-lobed bolls (in fine-staple varieties, usually 3-4-lobed), fiber color is silver-white-shiny,

early ripening (113-118 days), high yield (45) - 55 c/ha), a new type of fine-staple organic cotton, which is the only natural ecological product in our country and in the world. As a result of the development of this new promising eco-variety, the offspring of an organic cotton variety without gossypol has been obtained, it is necessary to expand its sown areas.

If we consider the history of the creation of a new ecologically clean, fine-fibered, non-hossypolny cotton variety, then when it was bred, first of all, applied selection was used, the effective use of advanced genetic and non-traditional breeding methods, the great scientist breeder A. Battalov, i.e. during hybridization,  $F_1$ -heterosis and  $F_2..F_5 .. - F_n$  offspring were obtained, repeated crossings, individual selection and repeated studies of the resulting offspring were carried out, and further individual selection and repeated studies of the offspring on resistant hybrids of the environment. Selection, morphological and phenological observations were carried out in all nurseries in order to determine their resistance to diseases, pests and adverse environmental conditions: drought, Afghan wind, salinity, cold, hail and other stresses. A breeding variety with an area of 12 hectares was tested. The results of the variety trial were positive. There are the most successful families and generations, divided into several notable groups. Purpose and objectives of the experiment. As a result, between species hybridization and multiple individual selection, re-crossing [(Bukhara-6 x Collection non- gossypol number) x Bukhara-9] and examination of offspring, it is possible to breed a variety that has a number of advantages compared to the standard variety, from which, under any extreme conditions you can get an early, high-quality harvest. Convenient for machine collection, environmentally friendly fine fiber and protein flour, oilseed waste for the production of a variety of products that will meet the needs of our people in nutritious, safe food and technical products and introduce them into production.

Thanks to the introduction of this new organic cotton variety, the following benefits can be achieved: more than 35.5 million people living in the country receive nutritious and healing, environmentally friendly food (protein flour, vegetable oil), raw materials from cotton organs and seed products;

- ✚ in addition, due to the absence of poisonous alkaloids in the seed kernel, the process of purification of vegetable oil from various toxins at oil and fat enterprises is reduced;

- ✚ compositional properties of organic and mineral substances in the seed nucleus remain unchanged, do not consume labor costs for additional cleaning, electricity;
- ✚ cost reduction for acid, gasoline, etc. (up to 45%);
- ✚ the yield of oil from seeds is higher than that of the technical grade of cotton grown in Uzbekistan (26%, sometimes even higher), on the one hand, it is environmentally friendly, and on the other hand, it is obtained by cold pressing, pressing;
- ✚ it saves resources, without additional costs (45% is spent to clean up toxic alkaloids), the low cost and medicinal properties of the oil are due to the absence of toxic alkaloids.

Previously, foreigners accepted cottonseed oil as an industrial oil, now recognized as an environmentally friendly consumer oil that can be bought in the global and domestic markets. The demand of foreign buyers not only for eco fiber, but also for seed products is high, and the volume of foreign investment and foreign exchange earnings to the state treasury will increase. The Republic of Uzbekistan will become one of the first cotton-producing countries capable of fully meeting the needs of the world market in all respects, producing the world's only new organic silk fiber and organic products. It will also serve as a breeding material (donor) for the creation of a new generation of eco-varieties of cotton in the future. The optimally promising new variety of eco-cotton, repeatedly selected and repeatedly tested in generations, will be transferred to institutions for state variety testing control. When creating seed farms, at least 5,000 kg of super-elite seeds will be grown and distributed. Due to the fact that eco-cotton is an organic product, a valuable sort of silk fiber, it is expected that in the future there will be a high possibility of its sale not only in Uzbekistan, but also abroad. A new variety of cotton, from which valuable silk fiber and environmentally friendly products are produced, will help the younger generation grow up harmoniously healthy, provide high-quality clothing, nutritious organic products. The name of Uzbekistan will be widely known in the world industry and cotton growing.

## Object and subject of research

By interspecific hybridization [Bukhara-6 x without gossypol alkaloid Bukhara-9] breed a new organic fine-fiber cotton variety on saline soils, in sharply

continental, soil-climatic and desert, very hot condition.

## Research methodology

Under the conditions of the Research Institute of Selection, Seed Production and Agricultural Technology of Cotton Growing at the Bukhara Scientific Experimental Station, research was carried out by the method of applied selection (interspecific hybridization) and multiple individual selection and testing of offspring. An environmentally friendly, fine-staple organic cotton has been developed. Genetically promising interspecific hybrid materials were selected and retested until stability was achieved. Were tested by comparison with a standard variety.

Breeding work "Methodological guide for breeding and seed production of cotton", developed at the Research Institute of breeding and seed production of cotton named after Zaitsev [18] and "Methodology of field experiments with cotton" [19] and "Genetics, selection and seed production" [20,21], determination of the accuracy criterion and the correlation coefficient was determined by the method of B. Dospikhov [22], "Methodology of field experience". Cotton yield was determined by hand weighing and weighing in individual bags of smaller and larger sizes by families and generations. Determined by weighing 100 pieces of selected cotton bolls on a scale. The weight of one box was determined by weighing and dividing the result by 100.

## Results and discussion

In 1977, interspecific (Bukhara-6 x Collection number without gossypol) hybridization and multiple individual selections were carried out, and as a result of the study, a stable and stable, high-yielding medium fiber without gossypol line L-20 (Bukhara-9) was obtained (in 1998). Ongoing long-term studies of multiple individual selection, repeated interspecies [(Bukhara-6 x Collection non-gossypol number x L-20)] crosses and re-examination of offspring, new promising fine-fibered non-gossypol varieties Bukhoro-9/1-I (in 2015) were obtained. The new variety was compared with the standard variety Termez-31 and foreign variety Turkmenistan 9647-I. Differs in an earlier ripening period (5-7 days), a larger mass of one cotton box (by 4-6 g), a yield of 15-20% higher, inferior in type to fiber and environmentally friendly protein flour, vegetable oil, seed waste and vegetative bodies for use in livestock, poultry, fisheries

and medicine. New organic fine-staple gossypol-free cotton that meets the requirements of the world market, is convenient for machine harvesting, and has a high fiber yield. In the course of the study, 5 types of nurseries were created, observations and analyzes were carried out in breeding nurseries.

Morphological, phenological indicators for various diseases, pests and stress resistance were studied. Every year, during the growing season of cotton, 3 approbations were carried out, during the approbation period typical plants of the variety were left, atypical ones were thrown away. All scientific work was recorded in the field book. As a result of individual selection and re-examination of their offspring, they were divided into groups of small-gossypol, non-gossypol, elite specimens of the family and the most profitable, promising Eco lines with economically valuable technological qualities were selected indicators, and samples of elite seeds were selected for reproduction. A comparison of economically valuable traits, technological and qualitative indicators of the selected lines of new eco-cotton with standard (Termez-31), foreign (Turkmenistan 9647-I) varieties was carried out, its advantages and differences were studied.

## The description of this line (L-20) was presented as follows

L-20- (Bukhara-9), resistant to fusarium and verticella wilt, also resistant to heat (45-50°C), drought-resistant, medium fiber, gossypol alkaloid is absent in all organs, high-yielding, early ripening, coarse-grained bred by A. Battalov and a group of scientists at the experimental plots of the Research Institute of Selection, Seed Production and Cultivation of Cotton Geotechnics at the Bukhara Experimental Station. In 2001-2006, the Scientific Research Institute of Selection, Seed Production and Cotton Cultivation of Agro technology of the Bukhara Experimental Station successfully passed the competitive variety testing at the variety testing and were renamed into a variety without gossypol of Bukhara - 9. In 2015-2016, as a result of multiple crosses and individual and multiple selection and testing of breeding offspring, among which fine-fiber and non-gossypol samples of cotton of the Bukhara-9/1-I variety were selected. The selected samples compared with the standard variety differed in weight (heavier by 4-6 g) of the boll, (types I and II) and yield (longer by 1.5-2.5 mm) and color (silver sheen) of the fibers, yield (45 - 55 c/ha), larger and five-lobed, early



ripening (113-118 days) and producing environmentally friendly products.

### Botanical description

- ✚ The bush is vigorous, height - 90-120 cm, cylindrical shape; monopodial branches reach from 0 to 3 pieces.
- ✚ The stem is slightly lowered, light green, at the end of the growing season from the sun it turns dark crimson and does not lodge.
- ✚ Sympodial branches of type I - 1.5, the height of the first fruit-bearing branches is 5 nodes, the color is light green.
- ✚ Leaves on the main stem are medium or large, on the main stem 5-lobed, on the fruit branches 3-5-lobed, light green, the degree of dissection is medium, the tips of the middle leaves are triangular;
- ✚ The size of the flower (crown) is medium in size; the color of the upper part is light yellow and the bases are orange. The presence of stains - does not have. Fiber adhesion in lobules is higher than adhesion to leaflets; teeth 13-15pcs. Medium size, egg-shaped;
- ✚ Bolls of large sizes, shape - ovoid-oval. The beak of the capsules is slightly pointed, less developed; the pits are less visible on the skin of the bolls. The upper part of the peel is light green, there are no gossypol alkaloids and the top of the cotton bolls is light lemon in color. Fiber adhesion in lobules is higher than adhesion to leaflets.
- ✚ Seeds are ovoid, large, pubescent, pale gray in color.

According to morphological characteristics, the variety differs from similar varieties of cotton in dark green color.

According to its biological characteristics, the Bukhara-9/1-I variety ripens 5-7 days earlier than the Bukhara-6 variety, depending on weather conditions and compliance with agricultural practices. The boll opens in 113-118-120 days, depending on the climate change over the years, and is one of the most early-ripening fine-fiber varieties.

Technological and economically valuable properties of raw cotton:

- Staple length (length code) 37-38
- Length in inches -1.24 -1.28;
- Micronair -3.4-3.8
- Strength (specific tensile strength) 34.2 g/text
- Rd (light reflectance) is 81.7.
- +b (yellowness level) - 7.83

- Pollution (dirt code) - 0
- SFI (short fiber index) - 3.7%
- Uniformity - 84.03%
- Relative elongation 9.8-9.0
- Oil content 23.0 - 26.0%
- Vegetation period - 113-118 days.
- Productivity - 45-50 and more c/ha.
- Fiber yield - 35 - 36%
- Fiber length - 38 - 41 mm.
- Fiber strength 4.6 - 4.7 g
- Weight of 1000 seeds - 130-150 g.
- Metric fiber number 7600-7800
- Fiber type - I - II

Figure 1-2-3-4- shows a general view of organic cotton, leaves, flowers and mature bolls, peeled cotton seeds, and the appearance of "protein flour" from it.



Figure 1: General view of the non-gossypol cotton variety Bukhara-9.



Figure 2: general view of leaves and flowers of eco cotton in the field.



Figure 3: General view of little gossypol and without gossypol cotton bolls.



**Figure 4:** protein flour and peeled seeds.

On a scientific basis, to find out how it complies with international standards in the textile industry and the production of environmentally friendly products of a new generation (natural medicines and biologically active substances) in animal husbandry, poultry farming, fisheries moreover, medicine. In addition, various laboratory analyzes and field observations were carried out to determine the resistance of this organic cotton to any stressful conditions. Also, the benefits were analyzed and justified using scientific indicators.

## Conclusion

As a result of many years of breeding research by scientists from the Research Institute of Selection, Seed Production and Agricultural Technology of Cotton Growing of the Bukhara Experimental Station, fine-fiber varieties that do not contain harmful gossypol have been obtained for humans and animals, both in vegetative and generative organs. They differ in the mass of one (4-6 g heavier) bolls with 5-lobed and the type of branching is not limited. It differs from all medium- and fine-staple technical cotton varieties grown in the modern world. Giving high-quality organic silk fiber, protein flour and edible oil, even in adverse weather conditions (salinization and heat, Afghan wind, drought, fungal diseases and spider mites, thrips, etc.), show their uniqueness and advantage, high economic efficiency.

In addition, the Republic of Uzbekistan is one of the leading countries in the world that has created ecologically clean varieties of medium and fine fiber, non-gossypol cotton, which is highly productive and high quality and resistant to various stress conditions.

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