

Development of Productive Cotton Cultivars with Increased Fiber Quality for Bukhara Region of Uzbekistan

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ABSTRACT

Bukhara region is one of the important agricultural regions for Uzbekistan, producing cotton as a leading crop in addition to cereals and horticultural crops. Agricultural production in this region is greatly suffered by soil salinization and water deficit that requires a specific effort in development of adapted crop cultivars for this harsh climatic environment. However, with development of scientific efforts and science-based facility in the provincial regions of Uzbekistan after independence in 1991, cotton breeders of Bukhara research centers took a concentrated effort to develop new cotton varieties, named after the ancient city 'Bukhara', which turned to be highly adapted to this region. These new varieties are 'Bukhara-6', 'Bukhara-8' and 'Bukhara-102' that significantly increased the cotton productivity of the region. The 'Bukhara-6' variety became the leading standard for other varieties of cotton cultivated in Uzbekistan because of its high textile quality among other varieties grown in Uzbekistan.

Keywords: cotton, Bukhara cotton varieties, fiber quality, seed-production, sustainable agriculture

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INTRODUCTION

Cotton is most important natural fiber crop in the world and a significant food and oil source for livestock and humans (Sunilkumar *et al.* 2006; Chen *et al.* 2007; Campbell *et al.* 2010). Cotton is the main cash crop for Uzbekistan and its production and export brings an average of ~\$0.9 to 1.2 billion annual economic income for the country (Abdurakhmonov *et al.* 2005; Abdurakhmonov 2007). This income is a major portion (22%) of all exports (Campbell *et al.* 2010) and GDP of Uzbekistan (Abdurakhmonov *et al.* 2012). Cotton is produced in all 12 provinces of Uzbekistan out of which Bukhara region is one of the largest cotton-producing areas (Nematov *et al.* 2004).

The Bukhara province is located in central and south-western part of the country. The territory of the region is made of hills and flatlands, the highest point of which is the Tamditau (922 m). At the same time, the Kyzyl Kum Desert occupies the nine tenths of the province. Some well-irrigated land is only in the south of the province, the oases of Gijduvan, Bukhara and Korakul. The climate is continental with very cold winters and hot summers with limited water resources available for agricultural production. The leading crop is cotton in addition to horticulture, grapes, and cocoons. The livestock farming is mainly oriented towards milk and meat production as well as for the produc-



Fig. 1 Cotton breeder A. Batalov and H. Nematov are conducting phenotypic observations with 'Bukhara-8' cotton cultivar in the field.

tion of karakul pelts. Karakul sheep is bred in pastures in the Kyzyl Kum Desert.

Table 1 Seed production characteristics.

Variety	Generation	Quantity, metric tons	Germination, %	Humidity, %	Weight, 1000 seeds, gr	Mechanical damage, %
Bukhara-6	Super elite	8.6	96	6	124	1.5
	Elite	74.7	96	6.4	124	3.5
	R-1	1507.7	96	6.7	124	4.2
Bukhara-8	Super elite	5.5	96	6	138	2.1
	Elite	52.7	96	6.7	138	4.8
	R-1	1159.5	95	6.6	137	5.1
Bukhara-102	Super elite	3	95	6	125	1.3
	Elite	26	95	6.5	125	2.8
	R-1	519.1	95	6.6	124	3.2
Jondor Kudrati	R-2	260.9	95	6.6	124	4.5
In total		7221.6				

As a leading crop, cotton production significantly suffered because of limited water resources that required development of adapted varieties for the region (Nematov 2004; Stat 2004). Cropping conditions of Bukhara region does not allow receiving a high yield of agricultural crops. The ~97% soil is salty with 35.7% low, 41.2% middle and 16.5% highly level of salinization. About 3.5% lands characterized with very saline soils. Therefore, in Bukhara region for production of a high crop, agricultural lands are annually washed out with the large amount of water in December and in January. In some highly saline regions (e.g., Kagan region) soil washing is carried out for multiple times. On the top of it, current shrinkage of Aral Sea strongly reflects on increase of salinity of agricultural lands (Nematov 2002, 2004).

To cope with these harsh environments in cotton farming, a highly productive and superior fiber quality cotton variety named 'Bukhara' has been developed and commercialized in the region (Nematov 2002, 2004). These new varieties (**Fig. 1**) are 'Bukhara-6', 'Bukhara-8' and 'Bukhara-102' that significantly increased the cotton productivity of the region due to improved drought tolerance characteristics. 'Bukhara-6' became the leading standard because of its high textile quality among other varieties grown in Uzbekistan. Since its commercialization in 1996, three different Bukhara varieties such as 'Bukhara-6', 'Bukhara-8' and 'Bukhara-102' are being cultivated in the region that occupy one third of the entire cotton area of Republic of Uzbekistan. Because of commercialization of these new varieties in Bukhara region, starting from 2007, the regional cotton fiber reprocessing factories became fully modernized with new equipment that increased the quality of fiber prepared. As a result, fiber quality is much better and as customers purchasing fiber bundles are very pleased with the quality of the fiber types of 'Bukhara'. Farmers receive very high profit with cultivation of 'Bukhara' varieties.

A HISTORY OF INTRODUCTION OF 'BUKHARA' COTTON VARIETIES

These 'Bukhara' variety series were obtained from interspecific hybridization. 'Bukhara-6' was developed by artificial hybridization of Tashkent-1 (middle stapled fiber variety of *G. hirsutum*) with *G. barbadense* accessions '9647-1' from Uzbek cotton germplasm resources. After hybridization, there were 24-years effort for backcrossing and multiple trait selection. Currently, 'Bukhara-6' occupies almost 95% of cotton area in the region. However, the main concern for growing 'Bukhara-6' in some areas of the province was its moderately late maturing phenotype.

Therefore, the 'Bukhara-8' was introduced in 2003 through artificial selection from 'Bukhara-6' biotypes by A. M. Battalov's group. The maturity of 'Bukhara-8' has been accelerated for 3-4 days compared to 'Bukhara-6'. Currently, 'Bukhara-8' is widely being cultivated in Kashkadarya, Surkhandarya and Navoi regions of Uzbekistan. Additionally, 'Bukhara-102' is introduced by S. Maksudov in 2004 through genetic hybridization of 'Bukhara-6' with early maturing *G. hirsutum* line 'L-4380', following the long term artificial selection process. The effort yielded a new cultivar

'Bukhara-102' with accelerated early maturity (for 5 days) compared to 'Bukhara-6', which is being widely commercialized in the Republic. In addition to these Bukhara varieties, in Bukhara region, prospective new variety 'Jondor Kudrati' have been developed from breeding of biotypes Bukhara variety series that are being commercialized in the region.

COTTON PROCESSING FACTORIES IN BUKHARA REGION

During independence period of 1991-2011, with the guidance of Uzbekistan President important reforms in branch of agriculture have been made. A farmer became the owner of the property and agricultural lands. As a result, a farmer is granted a special farming credits from the government and farmers become important leading force in development of agriculture. After modernization of agricultural enterprises, a farmer became the basic manufacturer of agricultural products in large quantity. For this reason, farmers in the Bukhara region work with great enthusiasm to produce high-quality agricultural products.

Despite above-mentioned challenging conditions for agricultural production, farmers of Bukhara region overcome difficulties and significantly increased the cotton production. For example, seed cotton productivity in average has been increased up to 3.1 to 3.4 metric tons/per hectare during 1991-2010. These achievements are because of introduction of adapted Bukhara varieties and improvement of cotton seed processing factories in the region. Because of modernization of the seed sector, cotton seeds that are being planted are certified by the "State Center for controlling seed quality" ('Gossemnadzorsentr') as well as regional association of cotton seeds and other corresponding organizations of region (Nematov 2004).

QUALITY AND QUANTITY OF COTTON SEEDS

Quality and quantity of seeds of cotton prepared in 2010 are shown in **Table 1**. In the Bukhara region, cotton seeds are produced by farmers who win the bidding competition for seed production work. In the Bukhara region, a total of 342,000 metric tons of raw seed cotton were made in 2010 including 7221.6 tones for seed production. In the Bukhara region, seeds of 'Bukhara-6', 'Bukhara-8', 'Bukhara-102' and also 'Jondor Kudrati' are planted. Cotton is harvested manually and fully curated by the governor of the region. As a result, seeds of raw cotton are prepared in high quality. The productivity of the 'Bukhara-6' and 'Bukhara-102' is identical. However, the productivity of 'Bukhara-8' is more than other cotton cultivars. For example, weight of one cotton boll of cotton 'Bukhara-6' is 7.8 g while it is 11 g for 'Bukhara-8'. The mass of 1000 seeds of 'Bukhara-6' is 124-125 g while it is 138 g for 'Bukhara-8' (**Table 1**). Industrial test results show that the basic fiber quality parameters of Bukhara variety series are superior to other cultivars grown in Uzbekistan including an Upland cultivar standard 'Naman-gan-77' (**Table 2**).

Table 2 Fiber quality characteristics of Bukhara varieties grown in Uzbekistan.

Variety name	Micronaire	Staple length, mm	Strength, g/tex	Uniformity, %	Elongation, %	Reflectance, %
Bukhara-6	4.49	35.81	30.74	82.53	9.76	79.67
Bukhara-8	4.54	35.71	31.05	82.8	9.11	78.87
Bukhara-102	4.45	36.03	31.23	82.7	9.54	79.84
*Namangan-77	4.5	33	25.2	83.4	8.7	79.1

* Namangan-77 is considered a standard *G. hirsutum* cultivar grown in the most regions of Uzbekistan

Table 3 Cotton processing factories and their capacity in Bukhara.

The name of factories	Year of modernization	Saved energy, kwat/sec	Fiber quality increase, %	Newly installed equipment, %	Seed preparation factories	Production rate before modernization (tons/day)	Production rate after modernization (tons/day)
Gijduvan	2007	83	100	100	Bukhara regional cotton-seed RLE Gijduvan	21	30
Shafirkan	2008	80	100	100			
Peshku	2008	70	100	100			
Ramitan	2008	77	100	100			
Bukhara	2007	73	100	100	"Karvon" cotton cleaning joint venture Uzbekistan and France	28	31
Kagan	2007	76	100	100			
Jondor	2009	78	100	100			
Korakul	2009	80	100	100			
Olot	2010	79	100	100			

MODERNIZATION AND PROMOTED INCREASE IN PRODUCTS IN COTTON PROCESSING FACTORIES

Raw seed cotton produced in Bukhara region is high quality and fiber of 'Bukhara-6' is the standard for other cotton cultivars. During past decades, Uzbekistan has hosted several world fair on sale cotton fiber in Tashkent. Representatives of more than 90 countries have signed the agreement on purchasing Uzbek cotton fiber in advance with the a huge request and interest for fiber bundles prepared from 'Bukhara-6.'

In the Bukhara region, a quality of raw seed cotton fiber has reached 100% after modernization and cotton processing factories saved electro-energy for more than 80%. There are two main cotton processing factories in the region that prepare seeds for farmers (Table 3). With the modernization of cotton cropping system, in the Bukhara region, 35-36 kg/ha cotton seeds are being planted compared to 90 and 110 kg/ha before modernization that gave an opportunity to save seeds, time and energy. All this promote production of a sustainable cotton crop in the Bukhara region (Nematov 2004).

CONCLUSIONS AND FUTURE PROSPECTS

Thus cultivation of 'Bukhara' cotton variety series in the Bukhara region, the productivity of cotton has significantly increased. 'Bukhara' variety series are the perspective cultivars for the economy of Uzbekistan that are commercialized in one third part of cotton fields of the Republic of Uzbekistan. For the last few years, in the Bukhara region, all cotton factories have been modernized, and new equipment has been received from abroad, bringing high economic incomes. Its high productivity, superior fiber quality and tolerance to harsh climatic conditions such as salinity

and drought make these 'Bukhara' cotton cultivars more attractive to farmers, government, and consumers.

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