Original Article

Main Directions Of Cotton Breeding

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Abstract

The rich initial materials collected in the selection process allow the creation of intensive cotton varieties. Organological evaluation of complex economic indicators, resistance to wilt, drought tolerance, seed oil content, botanical morphological features, and degree of phenotype similarity has been performed in hybrid, selection, and sorting materials at all stages of the selection process. Extensive research is being conducted to create new cotton varieties that are tolerant to all kinds of extreme conditions and have more potential than their predecessors.

Highly productive cotton varieties Ganja-110, Ganja-114, Ganja-132, Ganja-160, and Ganja-182 have been developed as a result of directional selection. These fast-growing varieties with high fiber yield and high-tech quality were tolerant to wilt disease and cultivated on farms. Their initial seed growing work was started, original and superelite seeds were prepared.

Keywords: cotton, variety, boll, fiber yield, breeding, wilt

To ensure the dynamic development of cotton production, to meet the needs of the weaving industry in raw cotton, it is very important to perform research for the creation of new cotton varieties which are productive, fast-growing, resistant to diseases and pests, plastic to environmental factors and have high fiber yield, quality, and high oil content in seeds [1,2,3].

The initial selection materials collected for many years in the Selection department of the Research Institute of Plant Protection and Technical Plants provide the basis for the creation of intensive cotton varieties. In the initial stage of the selection process, interspecific, geographical distant, backcross, complex-step hybridization methods are used annually to obtain hybrid forms with rich genetic potential [4].

Organological evaluation of complex economic indicators, resistance to wilt, drought tolerance, seed oil content, botanical morphological features, and degree of phenotype similarity has been performed in hybrid, selection, and sorting materials at all stages of the selection process. Extensive research is being conducted to develop new cotton varieties that are tolerant to all kinds of extreme conditions and have more potential than their predecessors [5,6,7]. The directional selection process resulted in the creation of the cotton varieties Ganja-110, Ganja -114, Ganja -132, Ganja -160, and Ganja -182.

We aimed to study cotton varieties in terms of productivity and quality indicators and apply them to farms.

Research methods

New cotton varieties were studied comparatively using Ganja-8 and AzNIXI-195 as standard in the experimental field of the Research Institute of Plant Protection and Technical Plants. Sowing was carried out in optimal time against the high agronomic background. Seeds were planted in 4 rows of beds 30 m long, using a 90 cm x 10 cm x1 plant scheme in 4 replicates.

Phenological observations. Phenological observations were carried out separately for each variety with odd numbers of replicates and recorded in germination, flowering, and ripening periods. It is better to conduct phenological observations and field revisions together with creative breeders.

Germination: Germination was observed daily to record. Based on visual assessment, the date of full germination was recorded on the appropriate forms for all replicates.

Flowering: The date of mass-flowering of each variety was recorded. The flowering of 50% of plants in each replicate is considered the onset of mass-flowering.

Ripening: Ripening was determined by the opening of healthy bolls in healthy plants. The bolls are considered to be opened by the appearance of the fiber as a result of cracking of the bolls. The plants having at least one opened boll are taken into account. When the number of such kinds of plants reaches 50%, this period is considered the beginning of ripening. Observations were made systematically after 20-30% of bolls are opened. The results were recorded on blanks.
***Determination of plant density*:** The plant density was determined after the assessment of rarity before ripening [8].

Samples: Samples were collected a few days before mass harvesting, usually by September 20, by taking 25-50 fully opened bolls from each replicates. The samples were collected from mature bolls located on the 1st-2nd place of the 2nd-5th fruit branches of a normally developed plant. They were weighed in the laboratory with accuracy up to 1.0 g.

***Determination of fiber yield*:** 50 pappi were taken in each replicate and weighed with accuracy up to 0.1g. The weight of the seed was subtracted from the weight of the pappus. The obtained value was divided by the weight of the pappus and multiplied by 100. Thus, the fiber yield was found in percentage [9].
After determination of the mass of a boll, the percentage of fiber, and the fiber length, the collected samples were sent to the quality laboratory. The following indicators were determined in the quality laboratory [10,11,12].

1. Breaking load of fiber, q/q.
2. Fiber linear density, m/teks
3. Relative elongation at break, qq/teks.
4. Staple fiber length, mm.

Mass harvesting: The first mass harvest was carried out when each cotton shrub had 20-30% fully open bolls, the second harvest was performed when it had 50-60% open bolls. Harvesting should be completed before the frosts [13,14].

Research

It is recommended to plant Ganja-110, Ganja-114, Ganja-132, Ganja-160, and Ganja-182 cotton varieties created by breeders on farms as they are superior to Ganja-8 standard variety in terms of quantity and quality.
Biomorphological, economically important traits and technological quality indicators of fiber in Ganja-110, Ganja-114, Ganja-132, Ganja-160, and Ganja-182 cotton varieties are described below.
Ganja-110 cotton variety was created by multiple-replicative directional selection from the Mutant-4/1 form (AzNIXI-104-EI-0.04%+PABT-1.0%+18 hours). The Ganja-110 cotton variety belongs to the medium fiber species *G. hirsutum* L. The shrub is compact, pyramidal, 90-110 cm high. The stalk is dense and strong, resistant to lodging, pale green, relatively weakly hairy. Fruit branches are formed at an acute angle, belong to branching type I-II. It has 1-2 monopodial branches. Leaves are medium-sized, dark green, moderately hairy with 3-5 lobes, the leaf blade is straight. The flower is medium-sized, yellowish. The petals and pollen are yellow. The boll is large, the surface is smooth and dark green, the shape is elongated, ovate, the tip is blunt, starry. The seed is medium-sized, moderately hairy with dirty emerald color. 1000 seed weight is 120 grams. It is resistant to wilt disease. The Ganja-110 cotton variety is fast-growing and the vegetation period is 118 days.
Economic indicators: potential productivity of the variety - 50-55 cwt/ha. The average yield in the competitive variety test - 42.5 cwt/ha, the weight of raw cotton in one boll - 6.2 grams. The length of the fiber in pappus - 36.1 mm, fiber yield - 38.5%, fiber production - 17.0 cwt/ha.
Technological quality of fiber: breaking load of fiber – 4.9 q.q., fiber linear density – 5980 m/teks, relative elongation at break – 29.1 q.q./teks, staple fiber length – 35/36 mm. The Ganja-110 cotton variety meets the requirements of type IV.

Table 1 Economic, biological, and technological indicators of the Ganja-110 cotton variety

No	Indicators	Unit	Ganja -110	Ganja -8
			Perspective variety	Standard variety
1	The number of days from full appearance to ripening	day	118	134
2	Gross harvest of raw cotton	cwt/ha	42.5	30.0
3	Fiber yield	%	38.5	36.1
4	Fiber production	cwt/ha	17.0	10.4
5	Fiber length in pappus	mm	36.1	34.4
6	The mass of raw cotton in a boll	gr	6.2	6.1
7	Breaking load of fiber	qq	4.9	4.7
8	Fiber linear density	m/teks	5980	6320
9	Relative elongation at break	q.q./teks	29.1	29.4
10	Staple fiber length	mm	35/36	34/35
11	Wilt infection	%	5.7	6.4

Ganja-114 cotton variety was created from the Mutant-4/11 form by the method of experimental mutagenesis using multiple-replicative directional selection. It belongs to the medium fiber species *G. hirsutum* L. The shrub is compact, pyramidal in shape, 100-120 cm high. The stalk is dense and strong, resistant to lodging. The first fruit branch is located in the 5-6th node. It is dark green, belongs to branching type I-II.

Leaves are medium-sized, light green with 3-5 lobes. The flower is medium-sized, pale yellow. The petals and pollen are yellow. The boll is medium-sized, has a smooth surface, ovate form, and light green color, the product is not shed, it has 4-5 lobes. Seeds are medium-sized, moderately hairy with dirty emerald color. The weight of 1000 seeds is 121 grams. The Ganja-114 cotton variety is fast-growing and the vegetation period is 120 days.

Economic and technological quality indicators of fiber: the average productivity of the variety in the Competitive variety test - 36.2 cwt/ha, the weight of raw cotton in one boll - 6.1 g, the length of the fiber in pappus - 36.4 mm, fiber yield - 39.8%, leaf production -14.4 cwt/ha. Breaking load of fiber– 4.6 q.q., fiber linear density 5893 m/teks, relative elongation at break - 27.2 q.q./teks, staple fiber length-34/35 mm.

The technological quality of the Ganja-114 cotton variety fiber fully meets the requirements of type V. The variety is considered resistant to Wilt disease with 3.8% infection.

Table 2 Economic, biological, and technological indicators of the Ganja-114 cotton variety

No	Indicators	Unit	Ganja-114	Ganja-8
			Perspective variety	Standard variety
1	The number of days from full appearance to ripening	day	120	134
2	Gross harvest of raw cotton	cwt/ha	36.2	30.0
3	Fiber yield	%	39.8	36.1
4	Fiber production	cwt/ha	14.4	10.4
5	Fiber length in pappus	mm	36.4	34.4
6	The mass of raw cotton in a boll	gr	6.1	6.1
7	Breaking load of fiber	qq	4.6	4.7
8	Fiber linear density	m/teks	5893	6320
9	Relative elongation at break	q.q./teks	27.2	29.6
10	Staple fiber length	mm	34/35	34/35
11	Wilt infection	%	3.8	6.4

Ganja-132 cotton variety was created by multiple-replicative directional selection from the Mutant-3/8 form (Mughan-395-NDMM-0.04% + 18 hours). The Ganja-132 cotton variety belongs to the medium fiber species *G. hirsutum* L. The shrub is pyramidal in shape and 120 cm high. The stalk is resistant to lodging, light brown, hairless, straight, 5-7 cm between nodes. The number of sympodial branches is 12-15 and they protrude from the stalk at right angles. The first fruit branch emerges from the 4-5th node. It belongs to branching type I-II. 1-2 monopodial branches are formed. The leaves are light green, hairless with 3-5 lobes. The flower is medium-sized, light yellow. The boll is medium-sized, ovate, smooth, light green in color, raw cotton is not shed. Productivity - 32.9 cwt/ha, fiber yield - 37.5%, fiber length in pappus - 35.5 mm, fiber production - 12.6 cwt/ ha.

Technological indicators of fiber: breaking load of fiber– 4.7 q.q., fiber linear density 5840 m/teks, relative elongation at break-27.4 q.q./teks, staple fiber length-34/35 mm. The Ganja-132 cotton variety is fast-growing and the vegetation period is 112 days. The main indicators of the variety are given in Table 3.

Table 3 Economic, biological, and technological indicators of the Ganja-132 cotton variety

No	Indicators	Unit	Ganja-132	AzNİXİ-195
			Perspective variety	Standard variety
1	The number of days from full appearance to ripening	day	112	119
2	Gross harvest of raw cotton	cwt/ha	33.5	27.8
3	Fiber yield	%	37.5	37.2
4	Fiber production	cwt/h	12.6	10.3
5	Fiber length in pappus	mm	35.5	35.0
6	The mass of raw cotton in a boll	gr	6.1	6.3
7	Breaking load of fiber	qq	4.7	4.3
8	Fiber linear density	m/teks	5840	6090
9	Relative elongation at break	q.q./teks	27.4	26.4
10	Staple fiber length	mm	34/35	33/34
11	Wilt infection	%	7.3	8.6

Ganja-160 cotton variety was created by multiple-replicative directional selection from initial forms. This cotton variety belongs to the medium fiber species *G. hirsutum* L. The shrub is compact, pyramidal in shape, 110-120 cm high. The stalk is moderately hairy, resistant to lodging. The first fruit branch is located in the 5-6th nodes. It has 1-2 monopodial branches. The leaves are medium-sized, light green, mostly 3-lobed. Flowers are medium-sized, petals and pollen are yellow. The boll is medium-sized, ovate, the surface is smooth, and it has no stars. The weight of raw cotton in one boll is 6.1 grams. It is relatively resistant to wilt disease. The vegetation period is 127 days. Productivity - 38.6 cwt/ha, fiber yield - 40.0%, fiber length in pappus - 35.3 mm, fiber production - 14.9 cwt/ha.
The technological quality indicators of the fiber are as follows: breaking load of fiber – 4.7 q.q., fiber linear density – 6440 m/teks, relative elongation at break – 30.3 q.q./teks, Staple fiber length – 34/35 mm. The Ganja-160 cotton variety is distinguished from other varieties with high fiber yields.

Table 4 Economic, biological, and technological indicators of the Ganja-160 cotton variety

No	Indicators	Unit	Ganja-160	Ganja -8
			Perspective variety	Standard variety
1	Vegetation period	day	127	134
2	Gross harvest of raw cotton	cwt/ha	38.6	30.0
3	Fiber yield	%	40.0	36.1
4	Fiber production	cwt/ha	14.9	10.4
5	The mass of raw cotton in a boll	gr	6.1	6.1
6	Fiber length in pappus	mm	35.3	34.4
7	Breaking load of fiber	q.q.	4.7	4.7
8	Fiber linear density	m/teks	6440	6320
9	Relative elongation at break	q.q./teks	30.3	29.6
10	Staple fiber length	mm	34/35	34/35
11	Wilt infection	%	5.8	6.4

Ganja-182 cotton variety was created by multiple-replicative directional selection from hybrid obtained as a result of Mutant -5/8 (AzNIXI-170-EI-0.06% + 18s) x Mutant-6/34 (3273-EI + PABT-0.06 + 1.0%) hybridization. The Ganja-182 cotton variety belongs to the medium fiber species *G. hirsutum* L. The shrub has a pyramidal shape and is 120 cm high. The stalk is resistant to lodging, dark brown, straight, internode distance is 5-7 cm. It belongs to branching type II. The first sympodial branch is located in 4-5th nodes. 1-2 monopodial branches are formed. Leaves are medium-sized, mostly 3-lobed, light green, hairless. The flower is medium-sized, light yellow. The boll is medium-sized, ovate, 4-5 lobed, slightly pointed, the surface is smooth and light in color, the product is not shed. The boll is medium-sized, ovate, 4-5-lobed, slightly pointed, the surface is smooth and light in color, the product is not shed. The seed is medium-sized, dirty emerald in color. The weight of 1000 seeds is 121 grams. Relatively resistant to wilt disease. Productivity - 33.2 cwt/ha, weight of raw cotton in one boll - 6.1 grams, fiber yield -37.3%, fiber production - 12.4 cwt/ha, fiber length - 35 mm in pappus. Technological quality indicators of fiber: breaking load of fiber – 4.7 q.q., fiber linear density – 5960 m/teks, relative elongation at break – 28.1 q.q./teks, staple fiber length – 34/35 mm. The Ganja-182 cotton variety is fast-growing and the vegetation period is 110 days.
In Table 5, economic, biological, and technological indicators of the Ganja-182 cotton variety are compared with the standard variety AzNIXI-195.

Table 5 Economic, biological, and technological indicators of the Ganja-182 cotton variety

No	Indicators	Unit	Ganja-182	AzNIXI-195
			Perspective variety	Standard variety
1	Vegetation period	day	110	119
2	Gross harvest of raw cotton	cwt/ha	33.2	27.8
3	Fiber yield	%	37.3	37.2
4	Fiber production	cwt/ha	12.4	10.3
5	The mass of raw cotton in a boll	gr	6.1	6.3
6	Fiber length in pappus	mm	35.0	35.0
7	Breaking load of fiber	qq	4.7	4.3
8	Fiber linear density	m/teks	5960	6090
9	Relative elongation at break	q.q./teks	28.1	26.4
10	Staple fiber length	mm	34/35	33/34
11	Wilt infection	%	6.4	8.6

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