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Specialized trait collections for the different selection directions in cotton. I. Specialized trait collections for improvement of economically valuable traits

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Abstract

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On the basis of established high indicators for the most economically valuable traits, specialized trait collections have been created as starting material for the various selection directions in cotton: specialized collection for high productivity; specialized collection for fiber length improvement and other quality indicators; specialized collection for higher lint percentage. Organization of the relevant collections was in accordance with the requirements of selection process for a complex evaluation as biological and economic qualities, adaptability to the specific conditions and others. With these, commercial geneplasm will be preserved, the varietal structure and the hereditary basis of Bulgarian selection will be enriched and expanded. Created specialized trait collections will facilitate the use of available genetic resources in the various directions of cotton breeding and are the basis for creating new cotton varieties with higher productivity and improved fiber quality.

Keywords: cotton; collections; productivity; fiber length; lint percentage; starting material

Introduction

Cotton is a major fiber crop of great economic importance for many countries. The main product for which it is grown is fiber. Cotton fiber has qualities such as hygroscopicity, softness and electroneutrality, and in many cases it is irreplaceable by artificial fibers. Cotton fabrics are preferred both for clothing and for other purposes (special technical fabrics, tarpaulins, chemical filters, etc.). Cotton seeds are rich in proteins and fats, they are used as food, for the production of oils for food and technical purposes or for animal feed.

Cotton is strategic raw material the demand for which is growing continuously worldwide. In the EU only four countries (Greece, Spain, Portugal and Bulgaria) have conditions for growing cotton. Considering that of the EU member states cotton is grown only in Greece and Spain, Bulgaria can occupy certain positions in this sector.

Cotton is a good livelihood for farmers and could provide good income and farm employment in rural areas. Creation and introduction of new varieties in practice is the main reserve for significant rise in cotton production in our country and its faster recovery.

In the period 1994–2017, 26 new cotton varieties were created and approved at the Field Crops Institute in Chirpan. These varieties were the result of the implementation of two differently targeted selection programs – creation of early maturing varieties with high genetic potential for yield and varieties with improved fiber quality. Different selection methods were used: to increase earliness and productivity intraspecific hybridization and experimental mutagenesis were the main methods; to improve fiber quality interspecif-

ic hybridization of *G. hirsutum* L. × *G. barbadense* L. and its combination with intraspecific hybridization was used.

In the first selection direction – for earliness and productivity, these were the varieties Chirpan-539, Chirpan-603 (Bozhinov et al., 1996), Beli Iskar, Beli Lom (Bozhinov & Bozhinov, 2004), IPTP Veno (Bozhinov & Bozhinov, 2008), Trakia, Helius (Valkova, 2009), Boyana (Valkova & Bozhinov, 2010), Philipopolis, Denitsa, Sirius (Valkova, 2014a; 2014b; 2017), Tsvetelina (Koleva & Valkova, 2019).

In the second selection direction – for fiber quality, the varieties created in this period were Avangard-264 (Koynov & Stoilova, 1996) Perla-267, Vega, Colorit, Darmi, Nataliya (Stoilova & Saldzhiev, 2000; 2005a; 2005b; 2008a; 2008b; 2010), Dorina (Stoilova & Nistor, 2012), Rumi and IPK Nelina (Stoilova & Meluca, 2013).

In recent years, the new cotton varieties Pirin, Perun (Koleva & Valkova, 2023), Kristal, Aida, Anabel, Tiara and Melani (Dimitrova, 2022a; 2022b; 2023) and Selena (Dimitrova & Nedyalkova, 2023) were created and approved. The varieties Pirin, Perun Kristal and Anabel were obtained by inter-varietal crossing, while the varieties Aida, Tiara, Melani and Selena were created by interspecific hybridization and backcross technology. Pirin, Perun and Kristal varieties are new achievements in cotton breeding for earlness and productivity, Aida, Anabel and Melani varieties are new achievements in cotton breeding for fiber quality.

Cotton breeding in our country is based on early ripening, high-yielding and with good technological fiber qualities of the Bulgarian, Uzbek, Greek and American varieties. Foreign and local varieties constitute the cotton genetic resources and are located at the Field Crops Institute in Chirpan. Bulgarian varieties are distinguished by specific morphological features and qualities, and above all by great early maturity. The selection of cotton in our country is mainly aimed at creating new early maturing varieties, with high productive potential and improved fiber quality, especially its length, well adapted to the specific growing conditions, resistant to abiotic and biotic stress. Introduction, creation and evaluation of new genetic material are of great importance for the success of cotton breeding programs.

Recently, cotton genetic plasm is very limited worldwide. Many of the new varieties are genetically modified and cannot be used in cotton selection in our country. GM cotton is not allowed to be grown in Europe. Many foreign varieties, mainly Uzbek, Greek and American, have made great contribution to the development of Bulgarian cotton selection. Traditional and immediate is the use of local varieties, alone or in crosses with foreign varieties, as starting material for creating new geneplasm and new more productive and better quality cotton varieties.

Cotton area in our country has been greatly reduced as a result of economic and other reasons. The varietal structure is highly restricted and cotton production is based on 1–2 commercial varieties. Many of the new varieties are not introduced and there is a danger of losing valuable genetic material and strong narrowing of the genetic basis of selection.

Update of the available gene pool is necessary, so that, on the one hand, to preserve the genetic diversity created in recent years and not to lose the most valuable traits, and on the other hand, to make its use easier and more efficient for selection. Many of cotton varieties and advanced lines, distinguished by high indicators for one or more economic traits, are of interest for inclusion in collections with specialized purpose, where to continue their research, conservation and use in selection.

The aim of this study was to create specialized trait collections as source material for the various directions of cotton breeding based on high indicators for the most valuable economic traits.

Material and Methods

On the basis of available genetic resources, varietal trials conducted at the Field Crops Institute in Chirpan and results of new cotton varieties testing in the IASAS system, and maximum levels of economically valuable traits, relevant to the selection, it was organized the construction of two large groups of trait collections with specialized purpose, for the various directions of selection.

First large group includes specialized trait collections based on high indicators for economically valuable traits: specialized collection for high productivity; specialized collection for greater length and other fiber trait quality improvement; specialized collection for higher lint percentage.

Second group includes specialized trait collections based on exceptional characteristics for ecological cotton production and heterosis selection: specialized collection based on colored cotton (brown and green); specialized collection based on naked seed genotypes of cotton; specialized collection based on cytoplasmic male sterility forms.

Organization of the relevant collections was in accordance with the requirements of selection process for complex evaluation of biological and economic qualities, adaptability to the specific conditions, resistance to abiotic and biotic factors.

Data on the most important economic traits as yield (kg/ha), lint percentage and fiber length (mm) are presented only for the samples with high average levels of the traits meeting the requirements of respective trait collection and for the

samples with exclusive features included in the collections for ecological cotton production.

This publication presents the first group trait collections relevant to the most valuable economic traits improvement.

Results and Discussion

Specialized trait collections based on high indicators of economically valuable traits

– Specialized collection for high productivity

Parameters: productivity (seed cotton yield and lint yield) – over 4.0% higher than the current standard cultivar for productivity; lint percentage and fiber length equal to or above the standard cultivar.

Main task of cotton breeding in our country is creation and implementation of new early-maturing and high-yielding cotton varieties, with genetic potential for yield over 4500-5000 kg/ha, which can be realized under suitable growing conditions.

These varieties must be of an ecologically plastic type, able to withstand sharply changing climatic conditions and be able to form high and stable yields over the years.

Yield of these varieties under optimal production conditions should be 2500-3000 kg/ha, and with severe soil and atmospheric drying it should be 1500-1800 kg/ha (Saldzhiev et al., 2008).

The varieties that are of greatest interest for the selection of high productivity are: from the older these are Chirpan-539, IPTP Veno, Denitsa, Helius and Rumi; among the latest these are Perun and Aida.

The cultivar Chirpan-539 was created by M. Bozhinov, L. Dimitrova and B. Bozhinov in 1994, by the method of intraspecific hybridization within the species *G. hirsutum* L., from the crossing of the Bulgarian cultivars Beli Izvor × Garant. The cultivar Chirpan-539 was included in competitive variety test in the period 1989-1993 and in state variety test in 1992-1994.

An early and productive cultivar, with high lint percentage. In the State Variety Test (1992–1994) the cultivar Chirpan-539 exceeded the standard cultivar Beli Izvor in seed cotton yield by 11.0% and in lint yield exceeded it by 14.3%. It showed better earliness and better fiber quality.

As a result of these qualities, it was recognized by the 49th Plenum of the State Variety Commission in 1994 as original and zoned for the whole country (Materials of the 49th Plenum of the State Variety Commission, 1994). It has been protected by Certificate No. 10409/30.11.2001, issued by the Patent Office of the Republic of Bulgaria in 2001. Since 1996, it has been national standard for earliness and productivity.

The cultivar Beli Iskar was created by M. Bozhinov and B. Bozhinov in 2003 from the crossing of the Bulgarian cultivar Ogosta × S-9070 (Uzbek). It was included in competitive variety test in the period 1996–2001 and in State Variety Test in 1998, 1999 and 2001, in three territorial units for variety testing – Radnevo, Boyanovo and Gorski Izvor.

This cultivar was higher yielding than Chirpan-539 and Chirpan-603. On average for six years (1996-2001) the cultivar Beli Iskar exceeded the standard cultivar Chirpan-603 by 9.6% in seed cotton yield and by 11.6% in lint yield. The cultivar Beli Iskar had lint percentage 38.6% or 0.7% higher than the standard cultivar (Bozhinov & Bozhinov, 2004).

According to State Varietal Commission data, on average for three years, Beli Iskar outperformed the standard cultivar Chirpan-603 in seed cotton yield by 4.8% and in lint yield – by 5.2%. It had better earliness and better fiber quality. As a result of these qualities it was recognized by the IASAS Cotton Expert Commission in 2003 (IASAS Reports, 2003). It was protected by Certificate from the Patent office of the Republic of Bulgaria in 2004 No. 10556/31.03.2004.

The cultivar IPTP Veno was created by M. Bozhinov and B. Bozhinov in 2007 from the crossing of the American cultivar DP-2156 × Chirpan-539. It was included in competitive variety test in 1998–2000 and in State Variety Test in the IASAS network – in 2001–2003.

In seed cotton yield, on average for three years (1998–2000), it exceeded the standard cultivar Chirpan-603 by 12.3% and in lint yield – by 17.4%. In fiber length it was equal to Chirpan-603, it had 0.8 g larger bolls and 2.0% higher lint percentage than the stabdard (Bozhinov & Bozhinov, 2004).

In the State Variety Test, in seed cotton yield of 2380 kg/ha, on average for 3 years (2001–2003), it exceeded the established standards – Chirpan-539 (for productivity) and Avangard-264 (for fiber quality), respectively by 6.5% and 9.7% and in lint yield – Chirpan-539 by 5.4%, Avangard-264 by 14.4%.

In 2007 it was approved by the Expert Commission of the IASAS and was protected by the Certificate for a new variety of plants No. 10793/30.09.2008 from the Patent office of the Republic of Bulgaria.

The cultivar Helius was created by N. Valkova in 2007 by the method of experimental mutagenesis, by irradiating seeds of the Uzbek cultivar C-6530 with gamma rays at dose of 150 Gy in 1994. From 2000 to 2006 it was in competition variety trials and in the period 2004–2006 it was in the IASAS (Exclusive Agency for Variety Testing, Approbation and Seed Control) system.

On average for seven-year period (2000–2006) the cultivar Helius exceeded the standard cultivar Chirpan-539 in

seed cotton yield by 14.2%, in September harvest by 9.9%, statistically significant at GD 1% for both indicators. As for the index of earliness (September harvest to seed cotton yield) it was equal to the cultivar Chirpan-539. The cultivar Helius formed larger bolls than the standard cultivar. In lint percentage and fiber length it was insignificantly inferior to the standard cultivar Chirpan-539. The height of 1st fruiting branch setting, which is relevant for the mechanized harvesting of cotton, for the multi-year period, has been signioficantly less than the standard cultivar.

On average for the period 2004–2006, from the three testing locations in the IASAS network, of the cultivar Helius 2810 kg/ha of seed cotton yield was obtained, exceeding the established standards the cultivar Chirpan-539 for productivity and the cultivar Avangard-264 for fiber quality by 8.4% (Table 1). In lint yield, on average for the period, it exceeded the cultivar Chirpan-539 by 4.3% and the cultivar Avangard-264 – by 13.3%. The growing season was 131 days, compared to 132 days for the standards. Height of the first fruit branch setting was 20.5 cm and approached the standards. September harvest average for the period was 1503 kg/ha, at 130 kg/ha for Chirpan-539 and Avangard-264. The lint percentage was 38.6%, with 39.9% for Chirpan-539 and 36.9% for Avangard-264.

Helius variety exceeded the approved standards in strength, it was equal to Chirpan-539 in modal and staple fiber length and was inferior to Avangard-264 (IASAS, 2004–2006). This variety at higher seeding density of 180–240 thousand plants/ha provided 13.5–14.6% high yield (Saldzhiev et al., 2014).

Helius variety was approved by the IASAS Cotton Expert Commission in 2007 and protected by a Certificate for a New Plant Variety – No. 10735/28.09.2007

Rumi variety was created by A. Stoilova in 2011 from the crossing of line No. 268 (Garant × Progress) Bulgarian selection with the American variety Deltapine 20. The pedigree method was applied. Rumi variety was included in competitive varietal trials in 2005–2010 and in the IASAS network it was tested in 2009–2010.

Rumi variety has higher productivity than the standard cultivars and combines other valuable qualities such as finer and longer fiber than that of the standard cultivar Chirpan-539. In the IASAS system, on average for the two years of testing, 2484 kg/ha of seed cotton yield was obtained from Rumi variety exceeding the average standard (the average of the two standards) and Chirpan-539 by 8.3%, Avangard 264 – by 8.6%. As for lint yield of 892 kg/ha it exceeded the average standard by 8.5%, Chirpan-539 – by 5.4%, Avangard-264 – by 12.1%. In September harvest it exceeded the standards by 10.9%. Vegetation period was 113 days and was equal to that of the standards. Height of first fruit branche was 20.4 cm at 17.9 cm for Chirpan-539 and 18.5 cm for Avangard-264. As for lint percentage Rumi variety was equal to Chirpan-539. Regarding the fiber technological parameters, it was closer to Avangard-264 (IASAS, 2009–2010).

Denitsa variety was created by N. Valkova in 2013 from the crossing of the varieties Chirpan-539 × Sicola 3.2. (American). In 2007–2009 it was in competition variety trials. In the IASAS system Denitsa variety was tested in 2011-2012.

Denitsa is an early ripening variety with high productivity and good fiber quality. In the State Variety Test Denitsa variety in September yield, on average for two years, exceeded Chirpan-539 by 5.2%, Avangard-264 – by 3.6%. In seed cotton yield it exceeded the two standards by 5.8% and 3.6% respectively, in lint yield – by 4.6% and 8.5%. In lint percentage, Denitsa was behind Chirpan-539 by 1.1% and exceeded Avangard-264 by 5.1%. Its fiber had great strength, high uniformity and good length. In 2013 it was approved by the IASAS and certified – Certificate for a new variety of plants No. 11030/30.12.2013.

Aida variety was created by remote hybridization, by crossing of the allotetraploid *Gossypium thurberi* Tod. × *G. raimondii* Ulbr. with Darmi variety – *G. hirsutum* L. and backcrossing of the triple hybrid (*G. thurberi* Tod. × *G. raimondii* Ulbr.) × Darmi with Darmi variety.

Aida variety was studied in competitive variety trials in 2014–2017. In the IASAS (Exclusive Agency for Variety Testing, Approbation and Seed Control) system it was tested in 2017–2018.

The results for seed cotton yields characterized Aida variety as high yielding and stable over the years. The excess of seed cotton yield by individual years remained relatively stable – 10.9–13.3%. The average seed cotton yield over four years (2014–2017) of the standard cultivar was 1615

Table 1. Performance of Helius variety in the State Variety Testing in 2004–2006

Varieties	Seed cotton yield		Lint yield		Vegetation period, days	Height of 1st fruit branch, cm	Lint percentage, %	September yield, kg/ha
	kg/ha	%/St	kg/ha	%/St				
Chirpan-539 – St	2590	100.0	1037	100.0	132	21.3	39.9	1300
Avangard-264	2590	100.0	954	92.0	132	20.6	36.9	1302
Helius	2810	108.4	1082	104.3	131	20.8	38.6	1503

kg/ha, of the Aida variety – 1771 kg/ha, which was 9.7% more. Aida variety outperformed the standard variety in lint yield by 5.7% due to the higher seed cotton yield (Dimitrova, 2022a).

In the IASAS system, Aida variety in seed cotton yield of 2328 kg/ha, average of the two years, exceeded the two standard cultivars Chirpan-539 and Avangard-264 by 11.3% and 14.7% respectively, the average standard – by 13.0% (Table 2). It surpassed them in September harvest and in lint yild (859 kg/ha) by 8.9% and 17.5%, the average standard – by 13.2%. In lint percentage – 37.0% it was inferior to Chirpan-539 by 0.7%, but surpassed Avangard-264 – by 1.1% and was leveled with the average standard.

This variety had advantage for some technological fiber properties exceeding both standards Chirpan-539 and Avangard-264. Its fiber differed with better spinning consistency index (SCI), greater Upper Half Mean Length, better uniformity in fiber length and better spectroscopy reflecting the RD difference. The short fibers content was very low. Aida variety had finer fiber than that of Chirpan-539, equalizing with Avangard-264. In fiber strength and fiber elongation it was leveled with the standard cultivars.

Aida variety was approved in 2019 and certified in 2020.

Perun variety was created by M. Koleva and N. Valkova through an intraspecific cross between Trakia variety and line No. 411 (Bulgarian selection) in 2007. This variety has been included in competitive variety test since 2012. In 2017–2018 it was in the system of the State Variety Testing, in which Chirpan-539 – for yield and Avangard-264 – for fiber quality were used as standards. In 2019 it was approved for inclusion in list A of the Variety List of the Republic of Bulgaria (Order No. RD 12-5 of 10.04.2019 of the Minister of Agriculture), and in 2020 it was certified by the Patent Office (Certificate No. 11200 P2/30.09.2020).

Perun variety in the competitive variety test conducted at the Field Crops Institute in Chirpan, in seed cotton yield of 1825 kg/ha, on average for 4 years, significantly exceeded the standard cultivar Chirpan-539 by 18.4% (Table 3). Higher yield this variety combined with higher setting of 1st fruit branch, at 18.4 cm compared to 17.1 cm for the standard. Perun variety in terms of lint percentage of 37% insignificantly was inferior to the standard by 0.4%. Regarding boll weight – 5.4 g and fiber length – 25.9 mm, Perun variety was equal to the standard cultivar.

The results for the economic qualities of Perun variety from the State Variety Test in 2017–2018 are presented in Table 4. Perun variety in seed cotton yield of 2255 kg/ha, on average for the two years of testing, surpassed the two standards, the cultivar Chirpan-539 – by 7.8%, the cultivar Avangard-264 – by 11.1%, the average standard – by 9.5%. In 2018 this variety realized higher yield of 2470 kg/ha and significantly exceeded the two standards, Chirpan-539 – by

Table 2. Test results of Aida variety in the IASAS system (state variety testing) in 2017–2018

Variety	Years of testing		Average	In % to average standard
	2017	2018		
	September harvest, kg/ha			
Average standard	1657	1765	1711	100.0
Chirpan-539	1669	1835	1752	102.4
Avangard-264	1645	1695	1670	97.6
Aida	1683	2285	1984	116.0
	Seed cotton yield, kg/ha			
Average standard	2047	2073	2060	100.0
Chirpan-539	2070	2111	2091	101.5
Avangard-264	2024	2034	2029	98.5
Aida	2070	2586	2328	113.0
	Lint yield, kg/ha			
Average standard	778	740	759	100.0
Chirpan-539	798	779	789	103.9
Avangard-264	759	702	731	96.3
Aida	787	931	859	113.2
	Lint percentage, %			
Average standard	37.9	35.7	36.8	100.0
Chirpan-539	38.4	36.9	37.7	102.4
Avangard-264	37.3	34.5	35.9	97.5
Aida	38.0	36.0	37.0	100.5

Table 3. Economic indicators of Perun variety (2012–2015)

Varieties	Seed cotton yield, kg/ha		Height of first fruit branch, cm		Boll weight, g		Lint percentage, %		Fiber length, mm	
	Mean	%/St	Mean	%/St	Mean	%/St	Mean	%/St	Mean	%/St
Chirpan-539 -St	1542	100.0	17.1	100.0	5.4	100.0	37.4	100.0	25.9	100.0
Perun	1825	118.4*	18.4	107.6*	5.4	100.0	37.0	98.9°	25.9	100.0
GD 5%	276	17.9	1.0	5.8	0.2	3.7	0.3	0.8	0.3	1.1
GD 1%	366	23.7	1.7	9.9	0.3	5.5	0.6	1.6	0.5	1.9
GD 0.1%	473	30.7	2.3	13.5	0.4	7.4	0.9	2.4	0.8	3.1

17.0%, Avangard-264 – by 21.4% and the average standard – by 19.1%.

Perun variety in lint yield – 759 kg/ha, on average for the test period, exceeded the two standards, Chirpan-539 – by 7.7%, Avangard-264 – by 16.3% and the average standard – by 12.0%. Differences in lint yield between the new variety and the standard cultivars were much more significant in 2018, which is explained by the significantly higher seed cotton yield realized by the new variety in this year. In the same year Perun variety, similar to seed cotton yield, reported the highest lint yield – 919 kg/ha, significantly exceeding the two standards, Chirpan-539 and Avangard-264, respectively by 18.0% and 30.9%, and the average standard – by 24.2%. This shows that the Perun variety had great potential for productivity in favorable environments. Perun variety in lint percentage – 37.7%, on average for the test period, was equal to Chirpan-539, exceeded Avangard-264 by 1.8% and the average standard by 0.9%. The two standard cultivars showed significant differences in lint percentage, more pronounced in the second year of the trial. In this year, Perun variety had the highest lint percentage exceeding Chirpan-539 by 0.8%, Avangard-264 by 7.8% and the average standard by 4.2%.

Results of the technological fiber analysis of Perun variety, according to IASAS data for 2017–2018, are presented in the Table. 5. Compared with the two standards, the fiber of this variety had better elongation, better RD difference reflection spectroscopy and better whiteness. The fiber of Perun variety was characterized as very white, in terms of color (whiteness) 11-1 in Radnevo and Burgas lacations in 2017 and 11-2 in Radnevo locations in 2018 surpassed both standards. Perun variety in fiber length – 25.48 mm, average for the two years, and in degree of spinning (SCI) was inferior to Avangard-264 and was equal to Chirpan-539. Regarding other technological fiber qualities as maturity, yellowness, strength, length and uniformity Perun variety was equal to the two standard cultivars.

This trait collection also includes the varieties Trakia, Boyana, Philipopolis, Denitsa, Sirius, Tsvetelina, Pirin, Kristal, Tiara, Snezhina, created in the period 2007–2023.

Trakia, Philipopolis (Valkova, 2009; 2014a) and Tsvetelina (Koleva & Valkova, 2019) were created by experimental mutagenesis, Sirius (Valkova, 2017) – by combining intraspecific hybridization with experimental mutagenesis, Tiara – through remote hybridization and backcross technology, and all the others – Boyana, Denitsa, Pirin, Kristal and Snezhina were obtained through intraspecific hybridization (Valkova & Bozhinov, 2010; Valkova, 2014b; Koleva & Valkova, 2023).

Table 4. Test results of Perun variety in the IASAS system in 2017–2018

Varieties	Seed cotton yield, kg/ha				Lint yield, kg/ha				Lint percentage, %		
	2017	2018	Mean	%/St	2017	2018	Mean	%/St	2017	2018	Mean
Av. standard	2047	2073	2060	100.0	778	740	759	100.0	37.8	35.7	36.8
Chirpan-539	2070	2111	2091	101.5	798	779	789	103.9	38.4	36.9	37.7
Avangard-264	2024	2034	2029	98.5	759	702	731	96.3	37.3	34.5	35.9
Perun	2043	2470	2255	109.5	780	919	850	112.0	38.1	37.2	37.7

Table 5. Technological fiber properties of Perun variety in the IASAS system during 2018

Varieties	Micronaire mic	Strength, g/tex	Maturity index	Mean length, mm	Uniformity, %	Moisture, %	Short fiber, 12.7 mm
Av. standard	4.92	27.5	0.87	26.37	82.4	7.4	8.4
Chirpan-539	5.00	27.3	0.87	25.91	82.3	7.3	8.6
Avangard-264	4.83	27.7	0.87	26.83	82.5	7.4	8.1
Perun	4.72	27.5	0.86	26.20	82.2	7.4	8.2

In the state variety test, Kristal variety in seed cotton yield was equal to the standard cultivar Chirpan-539, Tiara variety surpassed it by only 0.9%, Sirius variety – by 1.9%. All others outperformed the cultivar Chirpan-539, standard for productivity, in seed cotton yield by 3.4% (Trakia, Pirin, Snezhina varieties) to 5.0% (Boyana variety). In lint yield Sirius variety was inferior to Chirpan-539, Trakia and Boyana varieties were equal to it, and for the others the increase was from 1.5% (Pirin variety) to 4.4% (Tsvetelina variety). Increase in seed cotton yield and lint yield was more significant for Tsvetelina variety – 3.9% and 4.4% and for Snezhina variety – 3.4% and 3.1%. Seed cotton yields of 2013 kg/ha (Boyana variety) to 2783 kg/ha (Kristal variety) were obtained from these varieties. Lint yield varied from 749 kg/ha (Boyana) to 1412 kg/ha (Kristal variety).

All these varieties combined higher productivity with other valuable qualities. In a varietal trial conducted at the Institute in Chirpan during 2016-2019 the cultivars Helius and Trakia, Viki and Denitsa varieties had the best performance for productivity surpassing in seed cotton yield the standard cultivar Chirpan-539 by 18.7–24.2% (average for four year). They also surpassed it in lint yield by 6.5–23.2%. (Dimitrova et al., 2022)

Under our climatic conditions, in individual years, some foreign cultivars – Eva (Greek), Tabladila-16 (Spanish), Nazili 954 (Turkish), FR-H-1002 (Spanish) performed well in productivity. In competitive variety trial, conducted in 2016-2019, the cultivars Eva and Tabladila-16 in seed cotton yield, averaged over the period, exceeded the standard cultivar Chirpan-539 by 14.4% and 11.3% (Valkova et al., 2022). In comparative variety trials (2014-2017 and 2020-2021) the cultivar FR-H-1002 (Spanish) realized 97.5% and 94.5% (on average for four and two years) of the yield of the standard cultivar Chirpan-539 (Summary reports 2014–2017; 2018–2021).

– Specialized collection for greater fiber length and other fiber qualities improvement

Technical and commercial value of cotton fiber is determined by a number of technological characteristics. The most important are: length; strength; fineness; maturity; fiber uniformity in length; color etc.

Fiber length is of greatest importance, quality of resulting yarns and fabrics mainly depends on it. The longer fiber produces stronger, finer and smoother yarn.

Parameters: fiber length – more than 1.5 mm longer than the standard cultivar; productivity – equal to or above the standard cultivar; lint percentage – up to 3.0% below the standard at very long length – over 30 mm.

The varieties of greatest interest for fiber length breeding are Avangard-264, Perla-267, Vega, Colorit, Natalia and Darmi. The cultivar Avangard-264 was created by interspecific *G. hirsutum* L. × *G. barbadense* L. hybridization and the other 5 varieties were obtained by combining the interspecific hybridization of *G. hirsutum* L. × *G. barbadense* L. with intraspecific hybridization.

The cultivar Avangard-264 has marked the beginning of a new generation of varieties with better fiber quality, the result of development of a new breeding direction. This cultivar was obtained by interspecific hybridization of *G. hirsutum* L. × *G. barbadense* L. Established as a fiber quality standard since 1996, in fiber length modal (31.4 mm) and staple (34.4 mm) it exceeded the standard cultivar Beli izvor by 3.1 mm and 3.0 mm, respectively (Koynov & Stoilova, 1996). It surpassed the standard in fineness and according to data of the State Varietal Commission and in fiber strength. In earliness and productivity it was equal to the early and productive varieties of the Beli Izvor type. It was inferior to them in lint percentage (State Variety Commission Reports, 1994).

According to INTEX-OOD-Sofia data for the period 1990-1992 (Teodosieva, 1990; 1991; 1992) the Presley fiber strength in lb/mg was 9.1 (super strong) for Avangard-264 at 8.4 (very strong) for the standard cultivar. As for linear density – 1.73, Avangard-264 belongs to the group of fine cottons (from 1.25 to 1.75). In a complex of economic and technological fiber qualities, this variety was very highly rated. With a possible highest score of 80, Avangard-264 in 1990 had a score of 74 at 54 for the standard cultivar.

Perla-267, Vega, Colorit, Natalia and Darmi varieties were obtained by combining the interspecific *G. hirsutum* L. × *G. barbadense* L. hybridization with intraspecific hybridization and were the next new achievements in this direction (Stoilova & Saldzhiev, 2000; 2005a; 2005b; 2008a; 2008b; 2010).

Perla-267 variety is earlier and had finer fiber than Avangard-264. In the State Variety Test it had metric number of 5605 m against 5499 m for Avnagard-264. In fiber length modal (29.7 mm) and staple (32.7 mm) it was superior by 3.1 mm and 3.3 mm respectively, to the standard cultivar Beli Izvor. In fiber strength, it belongs to the group of „very strong“ cottons (from 8.1 to 8.5 lb/mg), it had bundle strength of 8.1 lb/mg (Pressley), specific strength – 42.5 (State Variety Commission Materials, 1999).

Vega and Colorit varieties combine longer fiber length with a high setting of 1st fruit branch – over 18.9-20.5 cm, which makes them very suitable for machine harvesting, and have larger bolls.

In the State Variety Test (1999–2002), Vega variety showed better technological fiber indicators than the cultivar

Avangard-264 – standard for fiber quality. The modal length was 29.2 mm and the staple length was 32.0 mm, by 1.3 mm longer than that of Avangard-264. In linear density (0.165 mtex) it was equal to Avangard-264.

According to IASAS data (2001-2003) the fiber of Colorit variety was 0.6–1.2 mm longer, with a better base and uniformity than that of Avangard-264. It exceeded Avangard-264 both in seed cotton yield by 3.9% and in lint yield by 4.5%.

Darmi and Natalia varieties in the State Variety Test (2002-2004 and 2004-2007) showed better productivity than standard varieties and in seed cotton yield surpassed Avangard-264 by 4.5–6.8%, Chirpan-539 (productivity standard) – by 2.2–3.6%, in lint yield they surpassed Avangard-264 by 7.1–7.4%. In these varieties better combination of fiber length and lint percentage was achieved compared to Avangard-264 as in lint percentage (38.9–39.1%) they exceed it by 2.3-2.5%. Natalia variety was superior to Avangard-264 in fiber length, fineness and strength. Darmi variety set the sympodial branches over 20.3 cm, which makes it very suitable for machine harvesting.

Natalia variety showed the longest fiber length of all tested varieties under the conditions of Strumica – Macedonia (Stoilova et al., 2014).

Fiber length is a genetically determined trait, but it is also influenced by environmental conditions, especially the amount of rainfall. The critical periods of dependence of fiber length on rainfall and temperature sum are July 11 – August 10, and for varieties with a longer fiber length of the Avangard-264 type this period was July 11 – August 20 (Stoilova, 2012). This is the period when this feature is formed and rainfall is most inportant for fiber growth and reaching its maximum length.

The latest cotton varieties Anabel, Melani and Selena have been added to this trait collection.

Anabel variety was obtained by intraspecific hybridization from the crossing of selection line No. 37 with Dorina varriety (No. 37 × Dorina). In the pedigree of maternal form – line No. 37, Progress variety of interspecific (*G. hirsutum* L. × *G. barbadense* L.) origin was involved. In the IASAS system, Anabel variety was tested in 2017–2018. It was approved as a new cotton variety in 2021. According to IASAS data, in seed cotton yield of 2026 kg/ha, on average for two years, it was inferior by 3.1% to the cultivar Chirpan-539 – standard for productivity and was equal to the cultivar Avangard-264 – standard for fiber quality. In lint yield of 793 kg/ha, it was equal to Chirpan-539 and exceeded by 8.5% Avangard-264, as a result of higher lint percentage – 39.1% against 37.7% and 35.5% for the standard cultivars. This variety has a number of valuable technological fiber qualities and in some respects exceeded both standards or was equal to Avangard-264 (Table 6). Compared to the standard cultivars, Anabel variety had better fiber spinning consistency index (SCI), which means better spinning, greater Upper Half Mean Length, lower micronaire, which means finer fiber, greater strength, which is important for yarn strength, and better spectroscopy with reflection of the RD difference.

The results obtained define Anabell variety as a very good combination of earliness, productivity and fiber quality. This makes it very valuable for cotton production and selection programs.

Melani variety was created by remote hybridization, from the crossing of the allotetraploid *Gossypium thurberi* Tod. × *G. raimondii* Ulbr. with Darmi variety – *G. hirsutum* L., and backcrossing the triple hybrid (*G. thurberi* Tod. × *G.*

Table 6. Technological fiber properties of Anabel variety according to the IACAS data, average for two years – 2017–2018

Fiber properties		Cultivars / Variety			
2017–2018		Average standard	Chirpan-539	Avangard-264	Anabel
Spinning, Consistency Index (SCI		116	114	118	124
Micronaire (Mic)		4.75	4.87	4.62	4.44
Maturity (Mat) Index		0.87	0.87	0.87	0.86
Upper Half Mean Length (UHML), *mm*		25.85	25.52	26.18	26.64
Uniformity (UL) %		82.0	81.9	81.9	82.0
Short fiber length (SFL), 12.7 *mm*		8.8	9.0	8.5	8.8
Fiber strength (Str), g/tex		27.9	27.8	27.9	29.0
Elongation(Elg), %		7.1	7.2	7.1	7.3
Spectroscopy reflecting the difference (Rd)		81.3	81.2	81.5	8.2
Yellowness (+b)		8.5	8.6	8.5	8.5
Color graduate (C Grad) Upland	2017	Radnevo	21-1	11-1	11-1
		Burgas	11-2	11-2	11-1
	2018	Radnevo	21-1	21-1	21-1

raimondii Ulbr. × Darmi) with Darmi variety. In 2017–2019, Melani variety was included in competitive variety trials, conducted in the experimental field of the Field Crops Institute in Chirpan. In the IASAS system, Melani variety was tested in 2019-2020. It was approved as a new cotton variety in 2021.

According to IASAS data, in September harvest and total seed cotton yield of 2784 kg/ha, on average for two years, it was equal to Chirpan-539 and surpassed Avangard-264 by 6.4%. In lint yield of 1066 kg/ha, it was inferior to Chirpan-539 by 4.5% and surpassed Avangard-264 by 5.7%. In lint percentage it was inferior to Chirpan-539 by 2.1% and was equal to Avangard-264. The results obtained for the September harvest, criterion for earliness, and seed cotton yield characterize this variety as earlier and more productive than Avangard-264. Melani variety has shown stable indicators for most fiber quality traits as length, uniformity in fiber length, fiber elongation, short fiber content, spectroscopy with reflectance of the difference RD, color grade, for the two years of testing. Compared to the standard cultivars Melani variety had better spinning consistency index (SCI), greater Upper Half Mean Length (UNML) than Chirpan-539, lower micronaire, greater strength and better spectroscopy with reflection of the difference RD (Table 7).

This variety showed better combination of economic traits and technological fiber qualities than the cultivar Avangard-264 standard for fiber quality.

Selena variety was also created by remote hybridization from the crossing of the allotetraploid *Gossypium thurberi* Tod. × *G. raimondii* Ulbr. with Dorina variety (*G. hirsutum* L.) and subsequent backcrossing with Darmi variety.

Selena variety was studied in competition variety trials conducted in 2017–2022 in the experimental field of the Field Crops Institute in Chirpan. In the IASAS system it was tested in 2021–2022. It was approved as a new cotton variety in 2023. Selena variety is an early and productive new cotton variety with improved fiber quality.

According to the IASAS data, in seed cotton yield of 2163 kg/ha Selena variety exceeded the two standard cultivars, Chirpan-539 – by 2.2%, Avangard-264 – by 1.3%, the average standard (average of the two standards) – by 1.8%. In lint yield of 95.5 kg/ha Selena variety was equal to Avangard-264, surpassed Chirpan-539 by 2.9% and respectively the average standard – by 1.4%. In lint percentage it exceeded Chirpan-539 by 0.4%, Avangard-246 – by 0.6%.

Selena variety had a number of valuable technological fiber qualities and in some indicators surpassed both standard cultivars. Compared to the two standard cultivars it had better spinning consistency Index (SCI), greater Upper Half Mean Length and fiber strength, lower micronaire, better spectroscopy with RD difference reflection than Chirpan-539, less yellowness than Avangard-264 and better fiber whiteness (Table 8).

Selena variety combines better productivity with better technological fiber qualities than the two standard cultivars.

– *Specialized collection for higher lint percentage*

Parameters: lint percentage – over 42.0%; productivity and fiber length – equal to or above the standard cultivar.

This collection includes the standard cultivar Chirpan-539 and Beli Lom, Dorina and IPK Nelina varieties.

The cultivar Chirpan-539 showed high and stable lint percentage in various environments (years) (Stoilova, 2012).

The cultivar Beli Lom was created by M. Bozhinov and B. Bozhinov in 2003, from the crossing of the Bulgarian selection line No. 176 (Beli Izvor × Garant) × 791–169 – Greek cultivar. On average for 6 years (1996–2001) in seed cotton yield the cultivar Beli Lom exceeded the standard cultivar

Table 7. Technological fiber properties of Melani variety according to the IACAS data, average for two years, 2019–2020

Fiber properties	Cultivars / Variety			
	Average standard	Chirpan-539	Avangard-264	Melani
Spinning, Consistency Index (SCI	108	108	107	118
Micronaire (Mic)	4.99	5.09	4.88	4.74
Maturity (Mat) Index	0.88	0.88	0.87	0.87
Upper Half Mean Length (UHML), *mm*	24.9	24.6	25.3	25.6
Uniformity (UL) %	81.4	81.5	81.2	81.9
Short fiber length (SFL), 12.7 *mm*	9.6	10.1	9.1	8.2
Fiber strength (Str), g/tex	27.2	27.5	26.7	28.3
Elongation (Elg), %	7.3	7.2	7.3	7.3
Spectroscopy reflecting the difference (Rd)	81.4	81.2	81.5	82.4
Yellowness (+b)	8.9	8.8	8.9	8.9
Color graduate (C Grad) Upland – 2017		21-1 11-1	21-1 11-1	11-2 11-1

Table 8. Technological fiber qualities of Selena varieties according to IASAS data on average for the two years 2021–2022

Fiber properties	Cultivars / Variety			
2020–2021	Average standard	Chirpan-539	Avangard-264	Selena
Spinning, Consistency Index (SCI	108	111	106	115
Micronaire (Mic)	5.41	5.42	5.39	5.15
Maturity (Mat) Index	0.87	0.87	0.87	0.87
Upper Half Mean Length (UHML), *mm*	24.77	24.98	24.56	25.62
Uniformity (UL) %	81.8	82.2	81.4	81.7
Short fiber length (SFL), 12.7 *mm*	8.8	8.3	9.3	8.5
Fiber strength (Str), g/tex	28.2	28.3	28.0	29.4
Elongation(Elg), %	9.0	8.9	9.1	8.9
Spectroscopy reflecting the difference (Rd)	80.8	80.3	81.3	81.5
Yellowness (+b)	8.7	8.5	8.8	8.5
Color graduate (C Grad) Upland – 2017	21-2 11-2	21-2 11-2	21-1 11-2	21-1 11-1

Chirpan-603 by 3.3% and in lint yield per hectare it exceeded it by 8.2%. The lint percentage of Beli Lom was 39.8%, which was 1.8% more than the standard cultivar and the best achievement for this trait in the Bulgarian cotton selection at the corresponding stage of its development (Bozhinov & Bozhinov, 2004).

Dorina variety was created by A. Stoilova and T. Nistor in 2010 at the Field Crops Institute in Chirpan. It was obtained trough selection of productivity, fiber length and lint percentage in the Romanian line T-89/2. From 2004 to 2010 this variety was included in competitive varietal trials carred out in the Field Crops Institute in Chirpan. Dorina variety was tested in the IASAS network in 2007–2008.

Dorina variety combines fiber length and lint percentage and has good productivity. In the IASAS system (2007–2008) in lint percentage (41.0%) it surpassed the standard cultivars and emerged as a variety with very high lint percentage. Dorina variety exceeded the two standards in seed cotton yield and lint yield, Chirpan-539 – by 2.0% and 4.8%, respectively, Avangard-264 – by 7.6% and 20.2%. This variety showed very good technological fiber qualities evaluated with the automated systems HVI and AFIS (Stoilova & Nistor, 2012).

IPK Nelina variety was created by A. Stoilova in 2012 by crossing the Bulgarian variety Perla-267 with the Romanian one T-073. This variety is highly productive and with high lint percentage. In the IASAS network (2009–2011) it equalized with the standard cultivars in seed cotton yield, but surpassed them in lint yield, Chirpan-539 by 2.6%, Avangard-264 by 8.8%. It had higher lint percentage than Chirpan-539 by 0.7%. In fiber length it surpassed Chirpan-539 by 0.41 mm and 0.54 mm, respectively modal and staple, and was inferior to Avangard-264 by 1.19 mm and 0.50 mm. In fiber strength it exceeded Avangard-264 and equalized with Chirpan-539. Its fiber was of greater uniformity than the two standard cultivars.

Among the varieties of Bulgarian selection, Anabel variety as well as some selection lines (Nos. 661, 662 and 664) derived from complicated crosses, expressed high and stable over years lint percentage of 42.1–42.8%, average for two years, by 1.4–2.1% over the standard cultivar Chirpan-539 (Table 9) (Annual report, 2018).

Some of foreign varieties FR-H-1001 and FR-H-1002 (Spanish) also had high lint percentage (41.3% and 40.9%)

Table 9. Economic performance of lines Nos. 661, 662 and 664 derived from complex crosses, 2017–2018 (two-year average)

Lines	Seed cotton yield, kg/da	In % to Chirpan-539	Boll weight, g	Fiber length, mm	Lint percentage, %
Chirpan-539	140.5	100.0	5.3	25.5	40.7
661	158.7	112.9***	5.0^0	25.5	42.8***
662	151.9	108.1**	5.0^0	27.0***	42.1**
664	148.8	105.9*	5.0^0	26.3**	42.2**
GD 5.0%	7.2	5.1	0.3	0.6	0.9
GD 1.0 %	9.6	6.8	0.4	0.8	1.2
GD 0.1 %	12.4	8.8	0.5	1.1	1.6

average for three years.

Line No. 489 during all studied years combined high lint percentage and long fiber. In 2018 its lint percentage was 42.0%, fiber length was 29.0 mm, compared to 39.6% and 26.8 mm for the standard cultivar Chirpan-539 (Annual Report, 2018)

Conclusions

On the basis of high indicators for the most economically valuable traits specialized trait collections have been created, which will be purposefully used as starting material in selection of cotton.

Created collections will facilitate the use of available genetic resources in the various directions of cotton selection and are the basis for creating new more productive and better quality cotton varieties.

IPTP Veno, Denitsa, Helius, Perun and Aida varieties are of the greatest importance for increasing the production potential of new Bulgarian cotton varieties. In the state variety test, these varieties surpassed the standard cultivar Chirpan-539 in seed cotton yield by 5.8% to 11.3%, in lint yield they surpassed it by 4.3% to 8.9%.

With the created trait collections, commercial geneplasm will be preserved, the varietal composition and the hereditary basis of Bulgarian selection will be enriched and expanded.

References

Annual Report of Field Crops Institue of Chirpan, (2018). (Bg).

Bozhinov, M. & Bozhinov, B. (2004). Beli Lom (393) and Beli Iskar (800) – new cotton varieties. *Rastenievadni nauki*, *41,* 380-383 (Bg).

Bozhinov, M. & Bozhinov, B. (2008). Veno – a new cotton variety. *Rastenievadni nauki*, *45*(3), 277-278 (Bg).

Bozhinov, M., Dimitrova, L. & Bozhinov, B. (1996). Chirpan-603 and Chirpan-539 – new varieties of cotton. *Rastenievadni nauki*, *33(2),* 35-38 (Bg).

Dimitrova, V. (2022a). A new cotton variety Aida. *Ratenievadni nauki* (*Bulgarian Journal of Crop Science), 59*(1), 43-50 (Bg).

Dimitrova, V. (2022b). Anabel – a new cotton variety. *Bulgarian Journal of Crop Science*, *59*(4), 56-63 (Bg).

Dimitrova, V. (2023). Agronomic performance and fiber quality of the new cotton varieties Tiara and Melani. *Bulg. J. Acric. Sci*., 29(4), 632-640.

Dimitrova V. & Nedyalkova, S. (2023). Selena – a new cotton variety. *Bulgarian Journal of Crop Science*, (in press) (Bg).

Dimitrova, V., Valkova, N., Koleva, M. & Nedyalkova, S. (2022). Directions and achievements of cotton breeding in Bulgaria. Proceedings of IV International Agricultural, Biological & Life Science Conference, Edirne, Turkey, 29-31 August 2022, 865-882.

IASAS (Executive Agency for Variety Testing, Approbation and Seed Control) – Main Directorate „Variety Testing, Approbation and Seed Control", Department „Variety Testing for Distinctiveness, Homogeneity and Stability and Biological and Economic Qualities" (2003-2022). Results of the Variety Test for Biological, Economic and Technological Qualities of Cotton (white cotton) (Bg).

Koleva, M. & Valkova, N. (2019). Tsvetelina – new high yielding variety of cotton. *Field Crops Studies*, *12*(1), 93-102 (Bg).

Koleva, M. & Valkova, N. (2023). Characteristics of the new cotton varieties Pirin and Perun. *Bulgarian Journal of Crop Science*, *60*(1), 69-77 (Bg).

Koynov, G. & Stoilova, A. (1996). Avangard-264 – a new long-fibered cotton variety. *Plant Scienses*, *33*(4), 13-15 (Bg).

Materials of the 49th Plenum of the State Variety Commission (1994).

Saldzhiev, I., Panayotova, G., Stoilova, A., Valkova, N. & Rashev, S. (2008). Cotton growing technology. *TEMKO* Stara Zagora, 2008 (Bg).

Saldhziev, I., Muhova, A. & Dobreva, St. (2014). Productivity and economic effect for cotton cultivated under different inter-row space and irrigation rate. *Turkish Journal of Agricultural and Natural Sciences*, Special Issue: 1, 1000-1004.

State Variety Commission Reports, 1994; 1999

Stoilova, A. (2012). Selection of cotton varieties and geneplasm with improved fiber quality. Theses of Dissertation D.Sc, Chirpan, Bulgaria (Bg).

Stoilova, A. & Meluca, Cr. (2013). Rumi and IPK Nelina – new cotton varieties. *Agricultural Science and Technology*, *5*(3), 247-251 (Bg).

Stoilova, A. & Nistor, T. (2012). Dorina – new cotton variety. *Rastenievadni nauki*, *49*(1), 7-12 (Bg).

Stoilova, A. & Saldzhiev, I. (2000). Perla-267 – a new cotton variety. *Rastenievadni nauki, 37,* 374-277 (Bg).

Stoilova, A. & Saldzhiev, I. (2005a). Vega – a new cotton variety. In the collection "Selection and agrotechnics of field crops". Balkan Scientific Conference June 1-2, Karnobat (Bg).

Stoilova, A. & Saldzhiev, I. (2005b). Economic qualities of the new cotton variety Vega. *Field Crops Studies*, *2(2),* 145-248 (Bg).

Stoilova, A. & Saldzhiev, I. (2008a). Colorit – a new cotton variety. *Rastenievadni nauki (Bulgarian Journal of Crop Science), 45,* 283-286 (Bg).

Stoilova, A. & Saldzhiev, I. (2008b). Darmi – a new cotton variety. *Rastenievadni nauki (Bulgarian Journal of Crop Science), 45,* 279-282 (Bg).

Stoilova, A. & Saldzhiev, I. (2010). Natalia – a new cotton variety. *Rastenievadni nauki (Bulgarian Journal of Crop Science), 47*(4), 373-378 (Bg).

Stoilova, A., Valkova, N., Spasova, Dr., Spasov, D. & Mihajlov, L. (2014). Agroecological assessment of new Bulgarian and Macedonian cotton varieties. *Bulg. J. Agric. Sci.*, *20*(2), 122-131.

Summarized reports of Field Crops Institue of Chirpan, (2014-2017; 2018-2021).

Teodosieva, N. (1990, 1991, 1992). Reports of "VEDA TEX COLOR", Sofia (Bg).

Valkova, N. (2009). Helius and Trakia – new cotton varieties. *Field Crop Studies*, *1*(1), 131-135 (Bg).

Valkova, N. (2014a). Characteristics of "Philipopolis" cotton variety. Jubilee Scientific Conference, 90 years Maize Institute, Kneja, September 10-11, 2014, Kneja. In: *Proceedings "Selection and Genetic and Technological Innovations in Cultivation of Cultural Plants"*, 206-214 (Bg).

Valkova, N. (2014b). Denitsa – a new high yielding cotton variety. *Field Crop Studies, IX(2),* 227-232 (Bg).

Valkova, N. (2017). New cotton variety Sirius. *Rastenievadni nauki (Bulgarian Journal of Crop Science*), *54*(1), 40-45 (Bg).

Valkova, N. & Bozhinov, M. (2010). Boyana cotton variety. *Field Crops Studies*, *6*(3), 395-398 (Bg).

Valkova, N., Sabev, P. & Koleva, M. (2022). Productivity and fiber quality of Bulgarian and foreign cotton varieties. *Bulg. J. Agric. Sci.,28*(6), 1056-1062.

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