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CHARACTERIZATION OF SOME DOMESTIC AND INTRODUCED VARIETIES OF COTTON IN THE AGRO-ECOLOGICAL CONDITIONS OF STRUMICA REGION

Lence Buseva[1], Dragica Spasova[1]*, Biljana Atanasova[1]
[1]Faculty of Agriculture, Goce Delcev University, Stip, Republic of Macedonia
**Corresponding author: dragica.spasova@ugd.edu.mk*

Abstract

During 2015-2016, research with 10 cotton varieties (lines *5136*, *5140* and *5141*, created at the Institute in Strumica and Bulgarian varieties *Chirpan 539*, *Veno*, *Perla 267*, *Avangard 264*, *Colorit 409*, *Helius 288* and *Natalia 361*) was done in the agro-ecological conditions of Strumica region. The aim was to study the biological and agricultural characteristics of cotton varieties. The experiments were done in three repetitions following a randomized block system and with size of experimental field parcel of 14m^2. All examined varieties in agro-ecological conditions in Strumica have fallen in medium early-matured varieties, with a vegetation period of 125-130 days. The lines belonging to the group of early-matured varieties had a vegetation period of 116-118 days. The seed cotton yields in the years of research were from 2853 kg/ha at the Bulgarian variety *Colorit* to 5158 kg/ha at the variety *Veno*. The highest lint percentage from the domestic genotypes was found for the line *5141* (42.6%), and for the Bulgarian genotypes *Chirpan 539* (45.4%) and *Helius 288* (43.8%).

Key words:*Gossypium hirsutum* L., *cotton* lint percentage, *yield, fibre length*

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is the most important fibrous culture in the world. It is grown in tropical and subtropical regions in more than 80 countries around the world. Of the 39 species of cotton plants, only four species are grown in order to obtain fibre. These are *Gossypium hirsutum*, *Gossypium barbadense, Gossypium herbaceum and Gossypium arboretum*. Virtually all the commercial cotton that is grown today are the varieties of American species *Gossypium hirsutum* and *Gossipyum barbadense*. *Gossypium hirsutum* covers more than 90% of cotton grown in the world and is the main source of textile fibres and is also produced for the production of oil. The quality of cotton fibre, such as hygroscopic, softness and electro-neutrality, in many cases makes it indispensable from artificial fibres. Cotton continues to be a culture of great economic significance in many developing and some developed countries (Rathore et al., 2006). Today, cotton covers for less than 3% of arable land in the world. Long cotton fibres are spun into thread for textiles, towelling, paper, banknotes, fishing nets, tents, nappies, wallpaper, bandages, surgical sutures, rope and sheets. Short cotton fibres, or linters, provide cellulose used for dynamite, sausage skins, lino, cellophane, rayon, photographic film, nail polish, etc. From the crushed cotton seed you get useful vegetable oil and the meal from crushed seeds is used for cattle feed, fish bait and organic fertilizer. Global cotton seed production can potentially provide a protein requirement for half a billion people per year. The cotton production in Macedonia depends a lot on early maturity of the cotton (Spasova et al., 2010, 2016).

The selection of varieties is one of the most important decisions in the selection of cotton. The various features depend heavily on the environment. Environmental conditions do not change only with geography but also from season to season in a particular area. It is important for manufacturers to know what the limiting factors are and to choose the appropriate variety.

The main objective of the study was to assess the new Bulgarian and Macedonian varieties of cotton in agro-ecological conditions in Strumica region, and to determine which of them are best for introduction into production or effective use in the breeding work. The research in our country and in the world is directed towards the following goals: Improving the quality of the fibre and seeds, developing varieties resistant of drought and diseases and early maturing.

MATERIAL AND METHODS

During 2015-2016, research with 10 cotton varieties (lines 5136, 5140 and 5141, created at the Institute in Strumica, Macedonia and Bulgarian genotypes Chirpan 539, Veno, Perla 267, Avangard 264, Colorit 409, Helius 288 and Natalia 361 created at the Field Crops Institute in Chirpan - Bulgaria) was done, in the agro-ecological conditions of Strumica region.

In both years of examination, basic soil treatment was carried out at a depth of 30cm from the autumn, and in the spring only additional processing was carried out.

The trials were set in three repetitions following a randomized block system, with each experimental parcel occupying an area of 14m^2. Sowing of cotton in the years of examination was performed 13 to 17 May.

The sowing was performed manually with 4-5 seeds in the nest, at a distance of 70 cm between rows and 20cm in row, leaving two plants in the nest.

During the vegetation, surveys and biometric measurements for the growth, development, and the birth of plants were performed. Before harvesting, 10 bolls were taken from each repetition, of each variety, that was 30 bolls of each variety. In the laboratory the mass of one boll, the lint percentage and the length of the fibre were determined.

The results were statistically processed by the method analysis of variance, and tested by LSD - test.

The soil and climate conditions in the area of research

The Strumica valley is situated on 200-300m altitude and it is under the influence of the Sub-Mediterranean and Eastern-continental climate. Precipitation is characterized by Mediterranean regime with a maximum in November and a minimum in the summer months (July or August).

The type of soil where the tests were carried out is alluvial, poorly supplied with humus and nitrogen, intermediately supplied with physiologically active phosphorus and well supplied with active potassium.

The weather conditions in the years of examination were different in terms of temperature and precipitation (Tab. 1 and 2).

Table 1. Average monthly temperatures in Celsius

Year	Month												Annual amount of temp.	Average annual temp
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		
2015	2.,8	5.3	7.2	12.4	19.8	21.4	26.7	24.9	20.1	13.8	8.8	3.0	5052.2	13.8
2016	1.4	9.4	9.5	15.5	16.9	23.5	25.5	24.2	19.1	13.4	7.2	1.3	5073.5	13.9
2004-2014	2.4	4.1	8.8	13.5	18.2	22.4	25.1	24.9	19.4	12.6	7.8	3.4	4927.5	13.5

Table 2. Amount of monthly precipitation in mm

Year	Month												Annual amount of precipitation in mm
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
2015	50.4	81.4	83.0	16.6	16.1	40.1	6.6	65.6	95.0	102.9	54.4	0.0	612.1
2016	61.3	23.5	135.5	52.5	96.2	38.3	18.7	18.7	31.4	64.3	53.3	0.0	593.7
2004 - 2014	43.5	51.5	50.5	44.0	66.3	60.1	52.0	39.9	61.0	80.1	48.3	66.9	663.9

In terms of temperature, 2015 was the most suitable for growing cotton throughout the whole vegetation. The high rainfall in August and September (160.6mm), which is 59.7mm above the perennial average, contributed to the fact that many fruiting elements remained unresolved. The temperature amount for the same period was 1.5°C above the perennial average, which contributed to the formation of high yield.

In 2016, the low amount of precipitation (37.4mm) in the months of July and August (during flowering and boll formation), which is 91.8mm below the multiyear average, contributed to the formation and retaining of less fruiting elements.

The temperature in both years was within the average value or slightly below the ten-year average.

RESULTS AND DISCUSSION

Phenological observations

Phenological observations are presented in Table 3. The germination in both years of research was from May 23 to May 29. The phase of budding of all examined varieties occurred in the second half of June. The blooming began from July 17-25. The biggest cracking of bolls was in the third decade of September. The bolls from the lines *5136* and *5140* cracked first, which is five to nine days earlier than the Bulgarian varieties.

All examined varieties in the agro-ecological conditions in Strumica region belong to the group of medium early-matured varieties with a vegetation period of 123-130 days, while the lines belonging to the group of early-matured varieties had a vegetative period of 119-122 days.

Table 3. Phenological observations and interphase period in days and height of plants per years.

Genotypes	Date of				Interphase period			
	Germination	Butonization	Blooming	Cracing of bolls	Germination Butoniz.	Butoniz. blooming	Blooming cracking of bolls	Germination cracking of bolls
	2015							
5136	23.05	24.06	17.07	19.09	32	24	63	119
5140	23.05	24.06	17.07	20.09	32	23	65	120
5141	23.05	24.06	18.07	22.09	32	24	66	122
Chirpan-539	24.05	25.06	19.07	24.09	33	24	67	123
Veno	24.05	25.06	18.07	25.09	33	23	68	125
Perla-267	24.05	25.06	19.07	28.09	33	24	68	127
Avangard-264	23.05	25.06	20.07	29.09	34	24	70	129
Colorit-409	23.05	24.06	18.07	29.09	31	24	72	130
Helius-288	23.05	24.06	18.07	26.09	32	24	67	125
Natalia-361	23.05	25.06	19.07	25.09	33	24	68	126

2016								
5136	28.05	29.06	24.07	27.09	32	25	65	121
5140	28.05	29.06	24.07	29.09	32	25	66	123
5141	28.05	29.06	24.07	28.09	32	25	64	122
Chirpan-539	29.05	29.06	25.07	29.09	31	26	66	123
Veno	29.05	30.06	25.07	02.10	32	25	67	127
Perla-267	28.05	30.06	24.07	03.10	33	24	69	128
Avangard-264	29.05	29.06	25.07	05.10	31	26	66	129
Colorit-409	28.05	29.06	25.07	04.10	32	26	68	129
Helius-288	28.05	30.06	24.07	30.09	33	24	67	125
Natalia-361	28.05	29.06	25.07	04.10	32	26	65	129

The number of fruiting elements of a plant is given in Table 4. The examined varieties differed among themselves on both the total number of young bolls and the number of detained or not fallen bolls per plants. In domestic lines, the number of young bolls ranged an average of 14.2 in the line 5136 to 20.7 in line *5141*. In Bulgarian varieties, the number of younger bolls ranged from 20.2 in Helius-288 to 28.2 in Veno.

Table 4. Number of young bolls per plant per year.

Variety	Young bolls number	Untouched	
		Number	%
2015			
5136	14 .0	12.0	85.7
5140	19.5	17.0	87.2
5141	25.0	21.0	84.0
Chirpan-539	39.0	33.0	84.6
Veno	44.0	34.0	77.3
Perla-267	25.5	22.5	88.2
Avangard-264	40.5	35.0	86.4
Colorit-409	38.0	32.0	84.2
Helius-288	27.5	23.0	83.6
Natalia-361	30.5	28.5	93.4
2016			
5136	14.5	5.5	37.9
5140	16.0	10.0	62.5
5141	16.5	7.5	45.4
Chirpan-539	12.5	7.5	60.0
Veno	12.5	7.5	60.0
Perla-267	15.5	7.5	48.4
Avangard-264	11.5	6.5	56.5
Colorit-409	11.0	7.0	63.6
Helius-288	13.0	7.0	53.8
Natalia-361	11.5	7.0	60.8

Productive characteristics of the varieties

In 2015, the variety Veno showed the highest yield – 5150 kg/ha, and exceeded the standard variety Chirpan-539 by 54.6% (Table 5). Very high yields of 4369-5019 kg/ha or 31.2-50.7% above the standard were obtained from Macedonian lines 5140, 5141 and Bulgarian varieties Helius-288, Natalia-361 and Perla-267.

The highest weight of the bolls were found for the genotypes 5136 – (7.4g) and Colorit-409 (7.4g), followed by 5140 and 5141 which had the same weight (7.2g), by 0.3-0.5g over the standard. The longest fibre was found for the Bulgarian varieties Colorit-409 (28.2mm) and Natalia-361 (28.1mm), whilst the shortest fibre

was found for lines 5140 (25.4mm) and 5136 and 5141 (25.5mm). The results for the fibre length were approximately equal in research (Spasova et al., 2009, 2016). As for the fibre lint percentage the varieties Veno and Perla-267 had the highest values – 46.2-46.9%, followed by Chirpan and Helius – 44.9%.

In 2016 also the variety Veno showed the highest yield of 5167 kg/ha and exceeded the standard Chirpan-539 by 40%. Except line 5141, all other varieties had a lower yield than the standard. Veno variety and line 5141 had the biggest bolls - 7.4g and 7.2g. The other varieties had boll weight of 6.1-7.1g. The longest fibre was found for Colorit-409 (27.6mm) and Natalia-361 (27.5mm), followed by Veno and Avangard-264 (27mm), while the lines had a shorter fibre. The highest lint percentage was obtained for Chirpan-539 - 46% and Avangard-264 - 43.9%.

The highest yield of 5158 kg/ha for two years was found for the genotype Veno which exceeded the standard Chirpan-539 by 47.3%. High yields of 4573 kg/ha and 4238 kg/ha by 30.7% and 22.2% over Chirpan-539 were obtained from line 5141 and variety Perla-267. The lowest yield of 2853 kg/ha was found for the variety Colorit-409 which is 18.2% below the standard. The highest bolls weight was found for lines 5136 - 7.3g, 5140 and 5141 - 7.2g, the smallest for Chirpan-539 - 6.5g. The others genotypes had boll weight of 6.7-7.1g. Similar results were obtained from other authors (Stoilova et al., 2014a; Stoilova et al., 2014b).

The fibre lint percentage ranged from an average of 41.6% in the line 5140 to 45.4% in Chirpan-539. The length of the fiber ranged from 25.1mm in 5140 and 5141 to 27.9mm in Colorit-409 and 27.8 in Natalia-361. In research by other authors, similar length of fiber was obtained (Spasova et al., 2016). In the both years of the examination, the highest total seed cotton yield was realized in the line 5141 (2735kg/ha) and the lowest in genotype Avangard-264 (1737kg/ha).

The Macedonian lines had shorter fibres than the Bulgarian genotypes.

Table 5. Productive and quality properties of varieties by years.

Variety	Row cotton yield kg/ha	In % to Chirpan-539	Boll weight G	Fiber length mm	Lint percentage%	Seed kg/ha	Plant height cm
	2015						
5136	3912	117.4	7.4	25.5	42.0	2321	104.0
5140	4492	134.8	7.2	25.4	42.4	2643	110.5
5141	4576	137.4	7.2	25.5	43.0	2643	119.0
Chirpan -539	3331	100.0	6.9	26.6	44.9	1833	104.5
Veno	5150	154.6	6.4	27.6	46.2	2770	116.5
Perla - 267	5019	150.7	6.7	27.6	46.9	2607	99.5
Avangard - 264	3264	97.9	7.0	27.7	43.6	1857	106.5
Colorit - 409	3007	90.3	7.4	28.2	45.7	1619	111.0
Helius - 288	4369	131.2	6.9	27.4	44.9	2405	104.0
Natalia - 361	4509	135.4	6.7	28.1	43.6	2571	103.0
LSD 5%	0.24	31.9	1.3	2.1	3.8	0.69	4.2
LSD 1%	0.34	43.6	1.8	2.8	5.2	0.95	5.7
	2016						
5136	3542	95.9	7.1	25.1	42.8	2038	109.3
5140	2614	70.8	7.2	25.1	40.8	1562	102.3
5141	4571	123.9	7.1	25.0	42.2	2828	118.3
Chirpan -539	3690	100.0	6.1	25.9	46.0	2680	106.0
Veno	5167	140.0	7.4	27.0	41.4	2524	113.0
Perla - 267	3457	93.7	6.9	26.9	41.1	2043	113.3
Avangard - 264	2838	76.9	6.8	27.0	43.9	1617	103.7
Colorit - 409	2700	73.2	6.7	27.6	40.3	1905	105.0
Helius - 288	3619	98.1	7.1	26.7	42.7	2033	111.0
Natalia - 361	2455	66.5	6.6	27.5	40.9	1464	105.7
LSD 5%	47.0	21.9	0.9	2.6	2.0	19.8	24.5
LSD 1%	64.3	29.9	1.2	3.5	2.8	27.0	33.3

CONCLUDING REMARKS

All examined genotypes in the agro-ecological conditions of Strumica region belong to middle early-maturing varieties with a vegetation period of 123-130 days, while the lines belong to the group of early-matured varieties with a vegetative period of 119-122 days.

The highest yield of 5158 kg/ha average for two years was found for Veno variety. The lowest yield of 2853 kg/ha was obtained for Colorit-409.

The highest bolls weight was accounted in lines 5136 - 7.3g 5140 and 5141 - 7.2g, the smallest in Chirpan-539 - 6.5g. The others genotypes had boll weight of 6.7-7.1g. The highest lint percentage was found for varieties Chirpan-539 (45.4%) and Helius-288 (43.8%). Macedonian lines had lower lint percentage about 42-43%.

The longest fibre was found for the Bulgarian genotypes Colorit-409 (27.9mm) and Natalia-361 (27.8mm).

On average, in both years of research all genotypes showed lower lint percentage compared to the standard.

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КАРАКТЕРИЗАЦИЈА НА НЕКОИ ДОМАШНИ И ИНТРОДУИРАНИ СОРТИ ПАМУК ВО АГРОЕКОЛОШКИ УСЛОВИ НА СТРУМИЦА

Ленче Бусева[1], Драгица Спасова[1]*, Билјана Атанасова[1]
[1]*Земјоделски факултет, Универзитет „Гоце Делчев" - Штип*
**Контакт автор: dragica.spasova@ugd.edu.mk*

Резиме

Во периодот од 2015 до 2016 година во агроеколошките услови на Струмица беа изведени експерименти со 10 генотипови на памук (линиите *5136*, *5140*, *5141*, создадени во институтот во Струмица и бугарските сорти *чирпан*, *вено*, *перла 267*, *авангард 264*, *колорит 409*, *хелиус 288* и *наталија 361*), а целта беше да се проучат биолошките и стопанските карактеристики на памукот. Испитувањата се извршени во три повторувања по рандомизиран блок систем со големина на експерименталната парцела до 14 m^2. Сите испитувани сорти во агроеколошките услови во Струмица спаѓаат во средно раностасни сорти со вегетационен период од 125 до 130 дена, додека линиите спаѓаат во групата на ранозрели сорти со вегетационен период од 119 до 122 дена. Приносот на суров памук во годините на испитување се движи од 2853 kg/ha кај бугарската сорта *колорит*, до 5158 kg/ha кај сортата *вено*. Највисок рандман од домашите генотипови има линијата 5141 (42.6%), а од бугарските генотипови кај *чирпан-539* (45.4%) и *хелиус-288*, (43.8%).

Клучни зборови: *Gossypium hirsutum* L., *памук, принос, рандман, должина на влакно*