

THE CHARACTERISTICS OF SOME MACEDONIAN WHEAT GENOTYPES IN ORGANIC AND CONVENTIONAL PRODUCTION

Mite ILIEVSKI¹, Dragica SPASOVA², Liljana KOLEVA-GUDEVA³, Milan GJEORGIEVSKI⁴,
Dalibor JOVANOVIĆ⁵

ABSTRACT

The examination was done during four years period (2004/05, 2005/06, 2006/07 and 2007/08) with ten Macedonian varieties soft winter wheat: *Milenka*, *Bistra*, *Lizinka*, *Altana*, *Mila*, *Orovcanika*, *Olga*, *Agrounija prima*, *Podobrena Orovcanika* and *Pelisterka*. The average height of varieties were 89,3 cm. Regardless the year, soil, climatic conditions and breeding system, variety with the highest yield was *Mila* (6 570 kg/ha) which in the conventional production system gave 5 760 kg/ha, but in the organic production 7 380 kg/ha. Independent of breeding system, the best content of proteins in grain had *Lizinka* (15,0 %), but the lowest content of proteins was detected at *Agrounija prima* (12,9 %). Regardless of breeding systems, year and varieties, the general average yields on Macedonian varieties were 5 877 kg/ha. These variety of soft winter wheat used 60-70% of its genetic potential for yield production.

Keywords: yield, varieties, wheat, organic, conventional, proteins.

INTRODUCTION

Soft wheat (*Triticum aestivum* spp. *vulgare*) is the basic and most important grain crop in lebna Macedonia. In the Republic of Macedonia surfaces and the average yield of wheat in the period after the Second World War to today, changed depending on the needs, the policy of the state, soil and climate conditions that prevailed during the years of production, assortment, etc. applied agrotechnics (Egumenovski et.al. 2003, Vasilevski, G. 2004).

In the Republic of Macedonia from 1951 to 2007 the wheat were grown from 80 000 to 140 000 hectares, while the average yield ranged from 0.88 to 3,52 t/ha with a total annual production of 90,000 to 380,000 tons of wheat grain.

¹ Assistant professor, Goce Delcev University - Stip, Faculty of agriculture, Krste Misirkov, b.b. P.O. box 201,2000 Stip, Republic of Macedonia (mite.ilievski@ugd.edu.mk)

² Assistant professor, Goce Delcev University - Stip, Faculty of agriculture, Krste Misirkov, b.b. P.O. box 201,2000 Stip, Republic of Macedonia (dragica.spasova@ugd.edu.mk)

³ Associate professor, Goce Delcev University - Stip, Faculty of agriculture, Krste Misirkov, b.b. P.O. box 201,2000 Stip, Republic of Macedonia (liljana.gudeva@ugd.edu.mk)

⁴ Assistant professor, Goce Delcev University - Stip, Faculty of agriculture, Krste Misirkov, b.b. P.O. box 201,2000 Stip, Republic of Macedonia (milan.georgievski@ugd.edu.mk)

⁵ Assistant, Goce Delcev University - Stip, Faculty of agriculture, Krste Misirkov, b.b. P.O. box 201,2000 Stip, Republic of Macedonia (dalibor.jovanov@ugd.edu.mk)

The average yield of wheat in the Republic of Macedonia for the period from 2000 to 2007 is 2670 kg/ha (farming, fruit growing and viticulture, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007. Statistics Views: Agriculture). When compared with the highest achieved yields per unit area in 1999 in European countries, Ireland (8147 kg/ha), England (8051 kg/ha), Belgium (7781 kg/ha), Germany (7543 kg/ha) and others, may be concluded that the country still lags far behind in terms of yield of wheat derived from a unit area.

Organic production in Macedonia is defined by law for organic production which is in accordance with the laws of EU and WTO.

In September 2007, MAFWE RM prepared the National Strategy and Action Plan for Organic Agriculture of the Republic of Macedonia for the period 2008-2011.

In our examinations we analysed the properties of the Macedonian ten genotypes of wheat in conventional and organic production in order to extract the most perspective and to recommend them to the producers, industry and breeders in Macedonia and beyond.

MATERIAL AND METHODS

The examinations were carried out on field and in laboratory conditions. The field trials were set up on the examination field of the Faculty of Agriculture in Strumica, of the University "Goce Delchev"-Stip. The examinations were carried out four years and 2004/05, 2005/06, 2006/07 and 2007/08 year. Ten varieties of soft winter wheat (*Triticum aestivum* spp. *vulgare*): Milenka, Bistra, Lizinka, Altana, Mila, Orovcanka, Olga, Agrounija prima, Podobrena Orovcanka and Pelisterka.

Varieties Milenka, Bistra, Lizinka Altana are selections from the Institute of Agriculture in Skopje, the variety Mila is selection of the Faculty of Agriculture from Strumica, while varieties Orovcanka, Olga, Agrounija prima, Podobrena Orovcanka and Pelisterka are selections of Agrounija LLC Skopje.

Each year of the period laid down for the examination two trials were done, in which both were represented all the above-mentioned varieties of soft wheat, except that in one experiment all varieties were grown in the system of conventional production, and other experiment in system of organic pTM

Both trials consisted of three repetitions with ten variants deployed by the method of random block system with the dimension of basic parcel 5 m². The distance between variants was 50 cm, and between repetitions - 100 cm. The distance between the rows in experiment with soft winter wheat which was applied to the conventional production system was 20 cm, while in the experiment with a system of organic production 10 cm.

The seeding norm for both systems of production was 300 kg/ha or 30 g/m², ie from 6,000,000 to 6,500,000 grains of 1 ha. In all the years of examination the culture before wheat was potato.

In the four years of examination soil was prepared in an identical manner. Thus, each fall was performed basic processing plowing the surface at a depth of 35 cm, followed by separation of surface and fertilization by methodological principle, so that the surface provided for the experiment where conventional production of soft wheat grain was applied artificial NPK 15:15:15 combination in a quantity of 300 kg / ha was applied, while the surface provided for the experiment with organic way of cultivation of soft wheat rubbed blown cow manure in quantities of 20 t / ha. After application of litter on the surface, it is further processed with milling machine and was leveled.

Sowing was performed manually with a hoe at a depth of 5-6 cm. In the conventional experiment standard agrotechnics for field wheat production is used. Treatment of crops with herbicide-based on 2,4-D, against broadleaf weeds with 2 l/ha was done. The stage booting was treated with Chromorel D at a concentration of 0.1% for suppression of the leaf beetle *Lema melanopus*. Nourishment of crops was done by KAN 27% -150 kg/ha, in the tillering stage of wheat.

In the experiment of organic production standard agrotechnic for organic production of the wheat was used. In addition to the surface provided for the experiment with organic way of cultivation of soft wheat is inflicted blown cow manure in quantities of 20 t/ha. The distance between rows in experiment with soft winter wheat was 10 cm. in the organic production. The nourishment in this experiment is left out, as other measures of conventional production where chemicals are used.

The height of the whole plant of wheat was measured. For this purpose, the height of the whole plant on 25 plants from each repetition was measured, whereby the average is taken from 75 plants (3 x 25 plants). The yield of grain was calculated in kg/ha based on the weight of grain received by each parcel, reduced per unit area.

Proteins were analyzed in the laboratory of genetics and selection at the Faculty of Agriculture and Food - Skopje. Proteins are determined on Infratec 1241 Grain Analyzer, by a patent method ER0320477B1, 8704886-4.

The results obtained are processed by the method variation statistical analysis of variance and differences tested by LSD-test.

Main Characteristics of the Wheat Varieties

Because of the complexity and specificity of the test genotypes, I think it is important to give a brief description of the characteristics of all varieties of soft winter wheat that were included in the trials.

Milenka

This is an early variety of soft winter wheat with excellent resistance to lodging. Resistant is to powdery mildew and less resistant to the leaf and stem rust. There is a high genetic potential and over 10 t / ha, while manufacturing and 8-9 t / ha. Average plant height is 85 cm.

Bistra

This is a middle late, new variety of soft winter wheat, which requires application of intense agrotechnics. It features very good resistance to lodging. There is a high genetic potential and over 10 t/ha, while manufacturing 7-8 t/ha. Average height of the plant is 86 cm. It has adaptability and high biological plasticity that allows greater distribution across all regions in R. Macedonia.

Lizinka

This is middle early variety of soft winter wheat which requires intensive use of technology. It features good resistance to lodging. Resistant is to powdery mildew and stem rust, a little less resistant to leaf rust. It is very durable at low temperatures. There is a high genetic potential and that over 9 t/ha, while production and is 6-7 t/ha.

Altana

This is an early newly made variety of soft winter wheat which requires intensive technology. It features good resistance to lodging. There is a high genetic potential and to 10 t/ha, while manufacturing and over 8 t / ha. Average plant height is 84 cm. This genotype is a good productivity, high quality, technological early mature ness, a function of greater resistance to drought.

Mila

This is an early intermediate newly made soft winter wheat variety that requires intensive technology. It features strong and supple tree that is resistant to lodging. This variety is biologically resistant to powdery mildew and rust and can be grown without chemical protection is carried out against these diseases. There is a high genetic potential move to 11 t/ha, while manufacturing and 8-9 t/ha. Average plant height is 74 cm.

Orovčanka

This is a medium early variety that was created in 1978 with crossing of the varieties Bezostaja 1 x SK-38. It is a soft winter wheat variety that requires intensive agrotehnics. It features strong and supple tree that is resistant to lodging. This variety is resistant to powdery mildew and rust and to fewer of the grain. There is a high genetic potential move to 9 t/ha. Average height of the plant class is 80 cm.

Olga

This is a medium early variety of soft winter wheat which is created by crossing of the varieties Agrounija prima x Mary. This variety is resistant to powdery mildew and rust and lodging and to fewer of the grain. There is a high genetic potential ranging to 10 t/ha. Average height of the plant class is 78 cm.

Agrounija prima

This is a medium early variety of soft winter wheat which is created by crossing of the varieties partizanka x 359 = F1 x partizanka.. This variety is resistant to powdery mildew and rust and lodging and to fewer of the grain. There is a high genetic potential ranging to 8-9 t/ha. Average height of the plant stem is 78 cm.

Podobrena Orovčanka

This is an early variety that is recognized by the Commission for recognition of sorts in 2003 with liner varieties Orovčanka x Balkans. It is a soft winter wheat variety that requires intensive agrotehnics. It features good resistance to lodging. This variety is resistant to powdery mildew and rust and to fewer of the grain. There is a high genetic potential up to 11 t/ha. Average height of the plant stem is 80 cm.

Pelisterka

This is late soft winter wheat variety that is created by crossing the varieties Partizanka x Skopjanka = F1 x CK-7. This variety is resistant to powdery mildew and rust and lodging and to fewer of the grain. Genetic potential and ranges over 10 t/ha. Average height of the plant stem is 80,56 cm.

Climate conditions

In the four years of the examination the metrological indicators average monthly air temperatures in degrees Celsius and monthly amounts of precipitation in millimeters were monitored (Table 1 and Table 2).

Table 1. Average monthly temperatures in degrees Celsius (°C)

Year	Months												Annual sum of temperatures	Average annual temperature
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		
2004	0,8	4,6	8,7	8,7	13,2	16,0	21,6	24,3	23,5	16,0	7,6	4,9	4896,5	12,5
2005	2,5	-0,1	7,8	12,9	18,7	21,9	25,0	23,8	19,4	13,2	5,4	4,2	4708,5	12,9
2006	-0,3	2,0	8,2	13,5	18,1	21,4	23,7	24,1	19,5	14,3	6,7	2,8	4672,0	12,8
2007	5,0	5,9	9,8	13,7	19,8	24,1	27,6	24,6	17,7	13,3	5,9	1,9	5146,5	14,1
2008	2,8	5,9	9,9	13,5	18,0	23,2	25,3	26,8	18,7	11,6	8,0	5,1	5135,6	14,0
1994														
2004	1,1	4,0	7,8	12,3	18,4	22,6	25,0	24,0	18,7	13,2	7,3	2,7	4831,2	13,2

Table 2. Amount of monthly precipitation (mm)

Year	Months												Annual sum of precipitations
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
2004	38,9	19,2	24,5	44,8	67,3	103,0	16,9	13,3	45,2	45,2	83,8	83,3	585,4
2005	48,9	96,4	43,5	36,7	50,0	12,9	35,5	75,9	63,9	58,0	34,2	52,1	608,0
2006	58,7	56,4	75,0	31,8	34,0	107	26,7	19,9	63,9	85,6	39,7	34,3	632,9
2007	16,5	24,0	39,7	2,2	107,5	45,6	0,3	73,9	41,0	127	74,8	41,4	593,7
2008	16,1	17,1	16,8	61,2	49,8	35,5	8,7	2,5	76,9	57,8	20,7	95,4	458,5
1994													
2004	48,0	33,7	36,4	48,9	51,5	49,3	57,8	34,9	53,8	57,7	60,3	81,9	614,2

RESULTS AND DISCUSSION

The results for plant height of the soft winter wheat in conventional and organic production are shown in Table 3 and 4.

Table 3. Plant height in cm in the examined varieties soft winter wheat in the system of conventional production

Variety	Year				Average by variety
	2004/05	2005/06	2006/07	2007/08	
<i>Milenka</i>	84,3	85,3	79,0	100,0	87,1
<i>Bistra</i>	89,3	85,7	79,3	100,0	88,6
<i>Lizinka</i>	102,3**	98,0**	77,7	98,0	94,0
<i>Altana</i>	80,7	84,3	74,3	104,0	85,8
<i>Mila</i>	84,7	84,7	83,3	103,0	88,9
<i>Orovčanka</i>	91,3*	91,7*	80,3	99,0	90,6
<i>Olga</i>	88,7	87,3	72,0*	81,0**	82,2
<i>Agrounija prima</i>	92,0*	94,3**	78,3	98,0	90,6
<i>Podobrena orovčanka</i>	84,7	86,3	76,0	98,0	86,2
<i>Pelisterka</i>	84,0	85,0	73,7	97,0	84,9
Average by year	88,2	88,3	77,4	97,8	87,9
LSD 0,05	6,00	4,41	6,84	7,76	General average
0,01	8,73	6,42	9,96	11,30	

Table 4. Plant height in cm in the examined varieties soft winter wheat in the system of organic production

Variety	Year				Average by variety
	2004/05	2005/06	2006/07	2007/08	
<i>Milenka</i>	84,7	87,3	87,0	95,0	88,5
<i>Bistra</i>	86,7	79,7**	87,3	96,0	87,4
<i>Lizinka</i>	94,0**	96,7**	84,7	94,0	92,3
<i>Altana</i>	84,3	85,7	84,3	93,0	86,8
<i>Mila</i>	87,0	91,3*	85,3	95,0	89,6
<i>Orovčanka</i>	95,0**	100,3**	97,3**	100,0	98,1
<i>Olga</i>	87,3	92,0*	89,7	86,0	88,7
<i>Agrounija prima</i>	87,7	85,3	95,7*	100,0	92,2
<i>Podobrena orovčanka</i>	93,0*	91,7*	86,3	99,0	92,5
<i>Pelisterka</i>	85,3	89,3	89,0	103,0	91,6
Average by year	88,5	89,9	88,7	96,1	90,8
LSD 0,05	6,21	3,80	6,48	n.s.	General average
0,01	9,05	5,54	9,44	n.s.	

Regardless of year, soil and climatic conditions and farming systems, the highest variety of examined genotypes was *Orovčanka*, which in conventional production system had an average height of 90,6 cm, and the system of organic production 98,1cm. This is due to genetic predestination of this sort, regardless of climatic conditions and applied agrotehnics, to grow high.

Regardless of age, varieties, soil and climatic conditions and farming systems, ie agrotechnics applied, the general average height of plants in a soft winter wheat was 89,3 cm.

The results for grain yield in kg/ha in the system of conventional and organic production of wheat are shown in Table 5 and 6.

Table 5. Grain yield in kg/ha got in the system of conventional production of soft winter wheat

Variety	Year				Average by variety
	2004/05	2005/06	2006/07	2007/08	
<i>Milenka</i>	4 540	4 620	3 500	7 800	5115
<i>Bistra</i>	4 700	6 020**	4 120*	8 000	5710
<i>Lizinka</i>	4 880	5 080*	3 680	5 000	4660
<i>Altana</i>	3 900	4 980	3 320	7 440	4910
<i>Mila</i>	4 080	6 120**	3 740	9 100	5760
<i>Orovcanika</i>	3 660	6 160**	3 680	5 940	4860
<i>Olga</i>	4 000	7 160**	3 020*	7 140	5330
<i>Agrounija prima</i>	4 880	6 260**	3 280	9 300	5930
<i>Podobrena orovcanika</i>	5 140	4 560	2 320*	7 240	4815
<i>Pelisterka</i>	4 880	5 060*	2 320*	6 840	4775
Average by year	4 466	5 602	3 298	7 380	5186
LSD 0,05	n.s.	433,3	400,0	n.s.	General average
0,01	n.s.	626,7	H.C.	n.s.	

Regardless of climatic conditions in the years of examinations in the conventional system of production the most yieldable varieties are agrounija (5930 kg/ha), Mila (5760 kg/ha), bistra (5710 kg/ha), Olga (5330 kg/ha) and Milenka (5115 kg/ha). These genotypes are best suited for this system of production to achieve relatively high yields. These varieties can serve as a future basic genetic material for the creation of sorts where we want to emphasize this property.

It can be concluded that the differences that occur between varieties in equal conditions of cultivation are due to different genetic varieties of the intention of creating a high yield of grain.

Table 6. Grain yield in kg/ha got in the system of organic production of soft winter wheat

Variety	Year				Average by variety
	2004/05	2005/06	2006/07	2007/08	
<i>Milenka</i>	6140	4560	6520	8060	6320
<i>Bistra</i>	6520	6580*	6520	8160	6945
<i>Lizinka</i>	6340	6520*	6120	6300*	6320
<i>Altana</i>	6140	5680*	6080	6040*	5985
<i>Mila</i>	8400	6640*	6640	7840	7380
<i>Orovcanika</i>	7020	6320*	7060	6240*	6660
<i>Olga</i>	7080	6880*	5440	6540*	6485
<i>Agrounija prima</i>	7120	6620*	7120	6640*	6875
<i>Podobrena orovcanika</i>	6640	6220*	6660	6760*	6570
<i>Pelisterka</i>	5640	6680*	5820	6440*	6145
Average by year	6704	6270	6398	6902	6568
LSD 0,05	n.s.	448,3	n.s.	522,6	General average
0,01	n.s.	n.s.	n.s.	n.s.	

Regardless of climatic conditions in the years of exploration in the system of organic production the most yieldable varieties are Mila (7380 kg/ha), Bistra (6945 kg/ha) and agrounija prima (6875

kg/ha). These genotypes are best suited for this system of production to achieve a relatively high yield and in future organic production we recommend to bring into production. These varieties can serve as a future basic genetic material for the creation of new varieties for organic production.

When compared with the average yield per year of both farming systems, regardless of varieties, and depending on the applied agrotechnical measures, we can say that in the system of organic production average yield was greater than in the conventional production system in the first, second and third year of examination, and lower in the fourth year.

Regardless of year, soil and climatic conditions and farming systems, varieties with the highest average yield of the tested genotypes was Mila (6570 kg/ha) which in the conventional system of producing gave 5760 kg/ha, and the system of organic production 7380 kg/ha.

The lowest average grain yield per unit area, regardless of year, soil and climatic conditions and farming systems, ie agrotechnics applied, give variety Altana (5447 kg/ha). That variety, in the organic system of production gave 5985 kg/ha, while in the conventional system of producing 4910 kg/ha.

Regardless of yearss, varieties, soil and climatic conditions and farming systems, ie agrotehnika applied, the general average yield of winter soft wheat is 5877 kg/ha.

The results for the protein content in grain in conventional and organic production of soft wheat are shown in Table 7 and 8.

Table 7. Content of proteins in the grain in % at the examined variants of soft winter wheat grown in the system of conventional production

Variety	Yea				Average by variety
	2004/05	2005/06	2006/07	2007/08	
<i>Milenka</i>	11,1	13,9	13,6	13,6	13,0
<i>Bistra</i>	13,4*	13,7	12,8	14,0	13,5
<i>Lizinka</i>	16,1*	15,9*	13,6	15,7*	15,3
<i>Altana</i>	11,0	15,5*	12,9	14,2	13,4
<i>Mila</i>	13,8*	13,0	14,2	13,9	13,7
<i>Orovcanika</i>	14,4*	13,4	13,8	14,5	14,0
<i>Olga</i>	12,9*	13,1	13,5	15,1*	13,6
<i>Agrounija prima</i>	13,0*	12,9	13,8	14,0	13,4
<i>Podobrena orovcanika</i>	14,9*	15,8*			15,1
<i>Pelisterka</i>	14,5*	15,1	14,0	14,1	14,4
Average by year	13,5	14,2	13,7	14,4	13,9
LSD 0,05	1,43				General average
0,01	n.s.				

Table 8. Content of proteins in the grain in % at the examined variants of soft winter wheat grown in the system of organic production

Variety	Year				Average by variety
	2004/05	2005/06	2006/07	2007/08	
<i>Milenka</i>	13,6	13,7	13,4	12,0	13,2
<i>Bistra</i>	12,9	13,3	13,4	13,0	13,1
<i>Lizinka</i>	15,1**	14,9*	14,3	15,1**	14,8
<i>Altana</i>	13,4	13,3	13,6	13,2*	13,4
<i>Mila</i>	13,3	12,2**	14,5*	12,7	13,2
<i>Orovcanika</i>	14,7*	13,1	14,4	13,2*	13,8
<i>Olga</i>	14,8*	12,7	14,5*	13,2*	13,8
<i>Agrounija prima</i>	13,1	11,5**	13,7	11,9	12,5
<i>Podobrena orovcanika</i>	15,3**	12,2**	14,3	13,9**	13,9
<i>Pelisterka</i>	14,7*	12,7	13,7	11,9	13,2
Average by year	14,1	13,0	14,0	11,6	13,2
LSD 0,05	1,03				General average
0,01	1,43				

Comparing the two varieties in farming systems with respect to this parameter, it can be concluded that all varieties except milenka and olga, grown in the conventional production system have greater protein content in grain grown in the same system of organic production

CONCLUSIONS

Based on four years of research (2004/05, 2005/06, 2006/07, 2007/08) Macedonian soft wheat genotypes grown in a system of conventional and organic production, the following conclusions can be made:

* All varieties, except for bistra and lizinka, in the system of organic production had higher average height of plants grown in the same system of conventional production.

* Regardless of year, soil and climatic conditions and farming systems, varieties with the highest average yield of grain is mila (6570 kg/ha) which in the conventional system of producing gave a 5760 kg/ha, and the system of organic production 7380 kg/ha.

* The highest percentage of protein in grain in the conventional production has variety lizinka (15.3%) and lowest (13.0%) variety Milenka. In the organic wheat production, the greatest content of protein in the grain had lizinka variety (14.8%) and lowest (12.5%) agrounija prima. Regardless of year, soil and climatic conditions and farming systems, varieties with the highest protein content in grain of tested genotypes was lizinka (15.0%), and the lowest agrounija prima (12.9%).

* Regardless of the climatic conditions in the years of examination in the conventional system of production the most yieldable varieties are agrounija prima (5930 kg/ha), Mila (5760 kg/ha), bistra (5710 kg/ha), Olga (5330 kg/ha) and Milenka (5115 kg/ha). These varieties can serve as a future basic genetic material for the creation of sorts where we want to emphasize this property.

* Regardless of the climatic conditions in the years of examination in the conventional system of production most suitable varieties for high protein content in grain are lizinka (15.3%) and podobrena or

* Agrounija prima, mila and bistra can recommend suitable and most stable genotypes for high yield with good quality in the conventional wheat production.

* Regardless of the climatic conditions in the years of examination in the system of organic production the most yieldable varieties are Mila (7380 kg/ha), bistra (6945 kg/ha) and agrounija prima (6875 kg/ha).

* Regardless of the climatic conditions in the years of examination in the organic production system suitable varieties for high protein content in grain are lizinka (14.8%), podobrena orovchanka (13.9%), Olga and orovchanka (13.8 %).

* Podobrena orovchanka, lizinka, mila, bistra, olga and orovchanka can be recommend as suitable and most stable genotypes for high yield with good quality organic wheat production.

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