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Technological Value of Selected Spring Wheat Cultivars Depending on the Sowing Date

Marta Wyzińska, Jerzy Grabiński, Alicja Sułek

***Abstract*—**The grain quality is a decisive factor in its use. In Poland, spring wheat is characterized by more favorable quality parameters in relation to the winter form of this species. In the present study, the effects of three different sowing dates (autumn, delayed autumn, and spring) and cultivar (Tybalt, Cytra, Bombona, Monsun, and Parabola) on the selected technological value parameters of spring wheat over three years were studied. The field trials were carried out in two locations (Bezek, Czesławice) in the Lubelskie Vivodeship, Poland. It was found that the falling number of spring wheat grains from autumn sowing dates was at a similar level to wheat sown in spring. The amount of wet gluten in the grain was variable in years, and its quality was better in wheat sown in spring. Sedimentation index was dependent upon on the cultivar.

***Keywords*—**Sowing term, spring wheat, technological value, quality.

I. Introduction

GRAIN for consumption should exhibit the high technological value (milling and baking), which is determined by qualitative parameters of grain and flour, such as: protein content, gluten quantity and meltability, sedimentation index, falling number, grain alignment, flour water absorption, and bread volume [1]-[4]. The research conducted so far, clearly shows that one of the most important factors determining grain quality are weather conditions [5], but also, genetically coded potential of the cultivar, as well as, to a large extent, habitat conditions and agrotechnical factors [6]-[9].

Literature on the impact of autumn sowing on the quality of spring wheat grain is poor. Taking into account the differences in grain quality between autumn and spring sowings of spring wheat, it can be concluded [10] that at the optimal sowing date, this quality is better. In the study conducted by [10], which compared the content of protein, gluten and Zeleny sedimentation index of spring wheat sown in autumn and spring, higher values of the above mentioned characteristics of spring sowing grains were obtained. However, [11] found that the autumn sowing had a positive effect on the 1000 grain weight. However, the weight of hectoliter of grains did not depend significantly on the date of sowing of spring wheat. A similar dependence of the effect of the sowing date on the weight of 1000 grains was found by [12]. Spring wheat from autumn sowing was characterized by a higher 1000 grain weight by 6 g compared to the one obtained in the spring term.

In Poland, spring wheat is characterized by more favorable quality parameters of grain and flour in relation to the winter form [5], [13], [14]. Woźniak and Staniszewski [5] found a higher content of total protein and wet gluten and the values of the sedimentation index of spring wheat grains compared to winter ones. The Zeleny sedimentation index was also higher in spring wheat.

M. Wyzińska is with Institute of Soil Science and Plant Cultivation – State Research Institute, Puławy, Poland (corresponding author, phone: 0048 81 47 86 814; fax: 0048 81 47 86 900; e-mail: mwyzinska@iung.pulawy.pl).

J. Grabiński and A. Sułek are with the Institute of Soil Science and Plant Cultivation – State Research Institute, Puławy, Poland (e-mail: jurek@iung.pulawy.pl, sulek@iung.pulawy.pl).

II. Material and Methods

Field tests were carried out in three growing seasons 2008/2009, 2009/2010 and 2010/2011 in two Research Stations for Cultivar Testing in Bezek (51°12′06″N 23°16′06″E) and Czesławice (51°30′69″N 23°24′67″E) belonging to the Research Center for Cultivar Testing (COBORU). The above mentioned experimental points are located in different regions of the Lubelskie Voivodeship.

The research was based on two-factor field experiments, set up with the method of randomized sub-blocks, in four replications. The first factor (A) was the date of sowing: I - autumn (2 - 3 weeks later than, as specified in the IUNG – PIB (Institute of Soil Science and Plant Cultivation – State Research Institute in Puławy, in Poland) agrotechnical recommendations, an acceptable delay for winter wheat), II - autumn (delayed compared to the first one by 1- 3 weeks), III - spring (indicated as the earliest possible in the agrotechnical recommendations of IUNG – PIB for spring wheat). The second factor (B) was spring wheat cultivar: 1) Tybalt, 2) Cytra, 3) Bombona, 4) Monsun, 5) Parabola.

The exact sowing dates of spring wheat are shown in Table I.

TABLE I
Sowing Dates of Spring Wheat

Location	Vegetation season	Sowing date I	II	III
Bezek	2008/2009	24.10.2008	14.11.2008	3.04.2009
	2009/2010	4.11.2009	21.11.2009	31.03.2010
	2010/2011	6.11.2010	20.11.2010	25.03.2011
Czesławice	2008/2009	24.10.2008	13.11.2008	2.04.2009
	2009/2010	26.10.2009	23.11.2009	29.03.2010
	2010/2011	22.10.2010	19.11.2010	2.04.2011

The concentration of K_2O in the soils, on which the experiments were set up, was at a high or very high level, while the concentration of P_2O_5 was at a very high level (Table II). A high magnesium content in the soil was also found. The analysis showed alkaline soil reaction in Bezek, neutral in

Czesławice.

TABLE II
SOIL FERTILITY (MG/100 G) IN PARTICULAR LOCATIONS AND YEARS

Location	Year	P_2O_5	K_2O	Mg	pH
Bezek	2009	45.9	37.3	1.7	7.5
	2010	35.0	28.0	2.7	7.5
	2011	46.5	28.0	3.2	7.5
Czesławice	2009	28.7	31.2	7.6	6.8
	2010	24.3	26.4	6.8	6.7
	2011	23.4	25.6	6.0	6.6

In order to determine the technological value of grains after harvest, representative samples of grain were taken using the principles of the PN-72/A-74001 standard. In grain samples, the amount of wet gluten, gluten index (IG), falling number, and SDS sedimentation index, were determined.

Weather conditions prevailing during individual growing seasons are presented in Tables III-VI.

TABLE III
THE MEAN MONTHLY TEMPERATURES IN PARTICULAR VEGETATION PERIODS IN BEZEK

Month	Temperature (°C)		
	2008/2009	2009/2010	2010/2011
X	9.8	6.8	4.8
XI	4.2	4.9	6.0
XII	0.3	-1.9	-4.7
I	-2.1	-9.2	-1.2
II	-1.8	-3.1	-4.9
III	0.9	2.5	2.2
IV	10.4	9.0	9.9
V	13.9	14.5	14.2
VI	19.0	17.6	18.2
VII	19.5	20.8	18.8
VIII	18.0	19.7	18.4

TABLE IV
THE SUM OF RAINFALLS IN PARTICULAR VEGETATION PERIODS IN BEZEK

Month	Rainfall (mm)		
	2008/2009	2009/2010	2010/2011
X	60.3	92.1	14.3
XI	26.7	74.4	45.0
XII	28.0	40.6	34.6
I	15.5	29.4	30.5
II	21.5	30.4	24.9
III	52.5	20.8	10.1
IV	10.1	20.4	30.6
V	86.8	72.4	40.8
VI	180.5	94.4	88.5
VII	50.8	156.0	178.9
VIII	46.9	141.9	38.5

The aim of the research was to determine the effect of sowing date on the technological value of the grains of selected spring wheat varieties.

The results were statistically analyzed using a one-way ANOVA, using the Statgraphics Centurion XVI computer program. Significance of differences between means were evaluated using the Tukey test at the level of significance p=0.05.

TABLE V
THE MEAN MONTHLY TEMPERATURES IN PARTICULAR VEGETATION PERIODS IN CZESŁAWICE

Month	Temperature (°C)		
	2008/2009	2009/2010	2010/2011
X	9.4	7.0	4.8
XI	4.0	4.8	5.8
XII	0.9	-1.4	5.4
I	-3.3	-8.3	-1.4
II	-1.2	-2.4	-4.1
III	1.3	2.3	2.6
IV	10.2	8.8	10.2
V	12.9	13.0	13.4
VI	15.8	17.5	18.5
VII	19.7	20.8	18.2
VIII	18.4	20.0	18.5

TABLE VI
THE SUM OF RAINFALLS IN PARTICULAR VEGETATION PERIODS IN CZESŁAWICE

Month	Rainfall (mm)		
	2008/2009	2009/2010	2010/2011
X	75.6	89.7	11.1
XI	34.3	48.6	54.6
XII	37.0	45.8	32.5
I	22.1	41.9	35.7
II	32.2	53.3	24.1
III	57.7	21.6	15.8
IV	0.0	29.0	33.9
V	72.5	116.2	53.1
VI	126.1	58.4	83.5
VII	54.7	84.8	160.0
VIII	56.2	147.1	36.7

III. RESULTS

A. Falling Number

The influence of experimental factors on the falling number of wheat grain in Bezek varied throughout the years (Table III). In 2009, the falling number was depended significantly on the wheat cultivar. However, no statistically significant differences were found in the values of this index among different sowing dates. The highest falling number was recorded for the grains of Tybalt and Cytra cultivars, while the lowest for Bombona and Monsun cultivars. The difference was almost 7%. The interaction among experimental factors, which influenced the value of this trait, was also found. At the first (I) sowing date, the grains of Cytra cultivar were characterized by the highest falling number, at the second (II) of cv. Monsun, while at the third (III) of cv. Parabola. In 2010, both the sowing date and the cultivar significantly had an influence on the value of the falling number. This parameter was the highest for spring sowing grains, while the lowest for the October sowing term. Analyzing the differences between cultivars, it was found that the grains of Monsun cultivar were characterized by the highest falling number, while the grains of Parabola cultivar by the lowest. The difference was

relatively large, amounting to 65.2%. In the third year of the study, the highest value of the falling number was also recorded for spring sowing grain, while the lowest for the first sowing date. The difference in the values of this parameter between the grain from the third (III) and first (I) sowing date was 12.8%. The highest mean value of this parameter was found for the grains of cv. Monsun, while the lowest for cv. Bombona.

In 2009, the falling number of grain samples from Czesławice did not significantly depend on experimental factors (Table IV). However, an interaction of sowing date and cultivar was found, which had a significant influence on the value of this characteristic. At the first (I) sowing date, the grain of cv. Parabola had the highest falling number, while at the second (II) cv. Bombona, and at the third (III) cv. Tybalt. The cultivars responded differently to the delay in sowing date. In 2010, both the date and the cultivar had significantly influenced the value of the falling number. Along with the delay in sowing date, the value of this technological parameter decreased. The difference between the first (I) and the third (III) sowing dates was 27.1%. The highest mean falling number was found for the grains of cv. Monsun, while the lowest for grains of cv. Parabola. The difference in the values of this parameter among these cultivars was significant, and amounted to 63.9%. The interaction among the experimental factors was also noted. For all sowing dates, the highest value of the falling number was found in the case of the grains of Monsun cultivar. The grains of Cytra, Bombona and Parabola cultivars, sown at the November sowing date, were characterized by the highest falling number. In 2011, the highest average values of this trait were recorded for the first (I) and third (III) sowing dates. Analyzing the differences between cultivars, the highest value of this parameter was found for the grains of Tybalt and Monsun cultivars, while the lowest for Bombona. The difference was on average 31%.

TABLE VII
FALLING NUMBER (S) OF WHEAT GRAIN IN BEZEK

Years	Sowing date (A)	Cultivar (B)					
		T	C	B	M	P	Mean
2009	I	411	434	395	370	359	394
	II	407	379	342	408	387	385
	III	401	403	401	357	406	394
Mean		406	406	379	378	384	–
$LSD_{0.05}$ for A = n.s.; B = 19.7; B/A = 34.1							
2010	I	234	106	150	230	103	165
	II	201	160	118	289	89	172
	III	238	200	122	296	92	190
Mean		225	155	130	272	95	–
$LSD_{0.05}$ for A = 25.0; B = 15.1; B/A = 26.1							
2011	I	210	138	111	232	111	160
	II	222	142	106	240	151	172
	III	237	207	135	234	105	184
Mean		223	162	117	235	123	–
$LSD_{0.05}$ for A = 20.5; B = 7.7; B/A = 13.3							

T = Tybalt, C = Cytra, B = Bombona, M = Monsun, P = Parabola, n.s. = not significant differences for p=0.05.

TABLE VIII
FALLING NUMBER (S) OF WHEAT GRAIN IN CZESŁAWICE

Years	Sowing date (A)	Cultivar (B)					
		T	C	B	M	P	Mean
2009	I	433	431	386	409	455	423
	II	392	412	439	405	433	416
	III	433	386	415	438	336	401
Mean		419	410	413	417	408	–
$LSD_{0.05}$ for A = n.s.; B = n.s.; B/A = 30.6							
2010	I	228	116	160	251	61	163
	II	148	138	186	212	114	160
	III	157	64	113	198	63	119
Mean		177	106	153	220	79	–
$LSD_{0.05}$ for A = 21.3; B = 11.8; B/A = 20.5							
2011	I	223	168	155	220	211	196
	II	222	134	153	209	192	182
	III	232	198	158	240	143	194
Mean		226	166	155	223	182	–
$LSD_{0.05}$ for A = 7.4; B = 9.1; B/A = 15.7							

T = Tybalt, C = Cytra, B = Bombona, M = Monsun, P = Parabola, n.s. = not significant differences for p=0.05.

B. Gluten Content

In Bezek, a different influence of the years of the study on the formation of gluten content was found in wheat grains. In the first year of the study, the amount of wet gluten washed out from wheat grain depended significantly on the date of sowing (Table V). Together with the delay in sowing date, the value of this technological parameter increased. Significant among cultivars were also found. The highest mean value of this parameter was recorded for the grains of cv. Bombona, while the lowest for cv. Monsun. The difference between these cultivars amounted to 16.8%. In all sowing dates, the highest amount of gluten was found in the grains of cv. Bombona. In the cultivars Parabola, Bombona and Cytra, the delay in sowing date had positively influenced the accumulation of gluten proteins in the grains. In the second year of the study (2010), the amount of wet gluten in the grains also increased with the delay in the sowing date. The differences between the first (I) and second (II) sowing dates were not statistically significant. The highest mean amount of wet gluten was found in the grains of cv. Cytra. In Bombona and Monsun cultivars, the amount of gluten proteins increased with the delay of sowing date. In the third year of the study, the highest amount of wet gluten was also found in the grains from spring sowing, while the lowest, from October sowing date. The difference in the value of this characteristic between the third (III) and first (I) sowing date was 18.9%. The highest mean value of this characteristic was recorded for the grains of Cytra, Bombona and Parabola cultivars (about 28%), while the lowest for Tybalt cultivars (24.9%). In the case of the all studied spring wheat cultivars, the delay in sowing date had a positive effect on gluten protein accumulation in grains.

In Czesławice, the date of sowing had significantly influenced the amount of wet gluten in wheat grains (Table VI). The highest values of this parameter were found for the third (III) sowing date. The difference among the first (I), second (II) and third (III) dates was 20%. Among the tested wheat cultivars, the highest mean values of this parameter

were found in the case of the grains of Cytra cultivar (27.2%), while the lowest in Tybalt, Monsun and Bombona cultivars (about 24%).

TABLE IX
GLUTEN CONTENT (%) IN WHEAT GRAIN IN BEZEK

Years	Sowing date (A)	Cultivar (B)					
		T	C	B	M	P	Mean
2009	I	26.4	26.4	28.5	25.5	23.7	26.1
	II	27.8	26.4	29.6	24.4	28.0	27.2
	III	26.7	28.5	32.1	25.2	30.6	28.6
Mean		26.9	27.1	30.1	25.0	27.4	–
$LSD_{0.05}$ for A = 0.48; B = 0.37; B/A = 0.64							
2010	I	22.5	23.8	19.8	19.6	23.4	21.8
	II	18.9	22.9	24.1	20.6	23.2	21.9
	III	23.6	27.1	26.4	24.9	24.4	25.3
Mean		21.7	24.6	23.5	21.7	23.6	–
$LSD_{0.05}$ for A = 1.18; B = 0.66; B/A = 1.15							
2011	I	23.0	27.0	25.7	21.8	26.1	24.7
	II	23.8	27.0	27.8	24.8	27.1	26.1
	III	27.7	30.2	32.2	29.3	32.8	30.5
Mean		24.9	28.1	28.5	25.3	28.7	–
$LSD_{0.05}$ for A = 0.76; B = 0.46; B/A = 0.80							

T = Tybalt, C = Cytra, B = Bombona, M = Monsun, P = Parabola.

TABLE X
GLUTEN CONTENT (%) IN WHEAT GRAIN IN CZESŁAWICE

Years	Sowing date (A)	Cultivar (B)					
		T	C	B	M	P	Mean
Synthesis from years 2009-2011	I	21.4	24.9	22.7	21.4	25.4	23.1
	II	23.0	25.7	22.4	22.7	23.4	23.4
	III	27.7	31.0	28.8	27.9	29.7	29.0
Mean		24.0	27.2	24.6	24.0	26.2	–
$LSD_{0.05}$ for A = 0.82; B = 0.38; B/A= 0.82							

T = Tybalt, C = Cytra, B = Bombona, M = Monsun, P = Parabola.

C. Gluten Index

In 2009 in Bezek, the significant influence of the wheat sowing date on gluten quality was found (Table VII). Along with the delayed sowing date, the quality of gluten deteriorated. The highest mean value of gluten index (GI) was found for Monsun cultivar, while the lowest for Cytra cultivar. The difference in the values of this index was as high as 74.9%. The GI value in the grains of Cytra, Bombona and Parabola cultivars decreased with the delay in sowing date. On the other hand, an inverse relationship was found in the case of the grains of Tybalt cultivar. In 2010, a higher average value of this index was found for wheat grains sown in the second (II) and third (III) term compared to the first (I) autumn term. In 2010, gluten washed from grains of Bombona and Monsun wheat cultivars, was of the best quality, while from Cytra cultivar of the lowest. In the following year of the study, together with the delay in sowing, the average gluten index decreased. The difference between the first (I) and third (III) term in this characteristic was 26.6%. The grains of Bombona cultivar were characterized by the best gluten quality while the grains of Cytra cultivar, by a very low quality. In the case of the grains of Tybalt, Bombona and Monsun cultivars, the quality of gluten deteriorated with the delay of the sowing date.

TABLE XI
GLUTEN INDEX OF WHEAT GRAIN IN BEZEK

Years	Sowing date (A)	Cultivar (B)					
		T	C	B	M	P	Mean
2009	I	63	36	82	88	93	71
	II	66	18	79	88	83	67
	III	73	10	58	57	60	58
Mean		68	21	73	85	79	–
$LSD_{0.05}$ for A = 10.2; B = 6.9; B/A = 11.9							
2010	I	23	24	92	92	87	64
	II	92	32	88	91	88	78
	III	84	36	90	88	86	77
Mean		66	31	90	90	87	–
$LSD_{0.05}$ for A = 6.9; B = 6.0; B/A = 10.4							
2011	I	91	12	93	93	79	73
	II	75	8	87	91	85	69
	III	67	9	77	65	52	54
Mean		78	10	86	83	72	–
$LSD_{0.05}$ for A = 1.3; B = 6.1; B/A = 10.5							

T = Tybalt, C = Cytra, B = Bombona, M = Monsun, P = Parabola.

In Czesławice, the highest values of the gluten index were recorded at the November sowing date, while the lowest values were recorded for the treatments with wheat sown in spring (Table VIII). Among the tested cultivars, the lowest mean value of this index was found for the grains of cv. Cytra. The index of other cultivars was at a higher and, at the same time, similar level. For the grains of Tybalt, Bombona, Monsun and Parabola cultivars, the highest values of the gluten index occurred at the autumn sowing dates.

TABLE XII
GLUTEN INDEX OF WHEAT GRAIN IN BEZEK

Years	Sowing date (A)	Cultivar (B)					
		T	C	B	M	P	Mean
Synthesis from years 2009-2011	I	92	39	93	93	89	81
	II	91	48	93	93	93	84
	III	87	39	90	83	78	75
Mean		90	42	92	90	87	–
$LSD_{0.05}$ for A = 3.5; B = 8.6; B/A = 12.2							

T = Tybalt, C = Cytra, B = Bombona, M = Monsun, P = Parabola.

D. SDS Sedimentation Index

In the studies carried out on wheat grains grown in Bezek, the highest values of the SDS sedimentation index were found for the second (II) and third (III) sowing dates (Table IX). Among the wheat cultivars tested, the highest mean value of this characteristic was found for the grains of Monsun, Parabola and Bombona cultivars, while the lowest for Cytra, whereas the difference was 29%. At the first (I) sowing date, the highest values of the SDS sedimentation index were found for the grains of Bombona, Monsun and Parabola cultivars, at the second (II) date of Bombona cultivar, while under spring sowing, of Monsun and Parabola. In the case of Tybalt, Cytra and Monsun cultivars, the value of this index increased together with the delay in sowing date. The value of the SDS sedimentation index of wheat grain cultivated in Czesławice

depended significantly on the date of sowing (Table X). The highest value of this index was recorded for the wheat grains from the second (II) sowing date, while the lowest of the wheat grains from spring sowing. Significant varietal differences were also observed. The highest values of the SDS sedimentation index were observed for Bombona cultivar grain, and the lowest for Cytra cultivar. The difference in the value of this characteristic was 31%.

TABLE XIII
SEDIMENTATION VALUE SDS (CM^3) IN WHEAT GRAIN IN BEZEK

Years	Sowing date (A)	Cultivar (B)					
		T	C	B	M	P	Mean
Synthesis from years 2009-2011	I	51	40	59	58	58	53
	II	55	42	66	62	63	58
	III	59	47	55	64	63	58
Mean		55	43	60	61	61	–
$LSD_{0.05}$ for A = 2.5; B = 11.2; B/A= 7.4							

T = Tybalt, C = Cytra, B = Bombona, M = Monsun, P = Parabola.

TABLE XIV
SEDIMENTATION VALUE SDS (cm^3) IN WHEAT GRAIN IN CZESŁAWICE

Years	Sowing term (A)	Cultivar (B)					
		T	C	B	M	P	Mean
Synthesis from years 2009-2011	I	58	48	71	64	69	62
	II	65	50	70	66	68	64
	III	65	49	71	68	69	55
Mean		63	49	71	66	69	–
$LSD_{0.05}$ for A = 2.2; B = 10.5; B/A = 6.3							

T = Tybalt, C = Cytra, B = Bombona, M = Monsun, P = Parabola.

IV. Discussion

A very important reason for the interest in spring wheat cultivation is its usually higher quality of grain than of winter forms. Research in this area concerned the basic characteristics. The value of the falling number is usually connected in practice with the problem of overgrowth [15]. Cacak–Pietrzak [16] states that the value of the falling number in the range of 220-270 s, indicates the optimal activity of amylolytic enzymes in grains processed into flour for bread baking. The minimum falling number at intervention buying-in of wheat grain is 220 s [17]. In our study, only in the case of grain from Bezek, the falling number depended significantly on the date of sowing, while the choice of cultivar significantly affected the value of this parameter in all growing locations. In the study by [18], the falling number of winter and spring wheat grains from the 2009-2011 harvest, ranged from 87 s to 393 s. The falling number of winter and spring wheat grains from the 2009-2011 harvest was in the range of 87 s to 393 s. The author does not find any significant differences in the falling number depending on the year of harvest. However, [19]-[22] did not find significant differences in the falling number depending on the wheat cultivar. In the studies of [23], the grains of spring wheat cultivars had a very high falling number (over 320 s), which indicates their low amylolytic activity. At the same time, it was found that the value of this trait significantly depended on the different habitat conditions in which different spring wheat cultivars were grown. Studies [24] indicate that the value of this parameter in spring wheat was primarily influenced by the cultivar factor. In the grains of Katoda, Łagwa and Waluta wheat cultivars, the activity of amylolytic enzymes was low (lower than 300 s), whereas in cv. Ostka Smolicka, it was at a medium level (273 s). The results of earlier studies [25]-[28] also indicate that this characteristic is primarily influenced by the cultivar factor and the course of weather conditions both during plant growth and grain harvest.

Among the proteins found in wheat grains, gluten proteins are of great technological importance [17]. At the molecular level, gluten constitutes a spatial network made up of polypeptide chains, bonded together by transverse intermolecular bonds. Gluten forms viscoelastic membranes, and maintains the proper consistency and structure of the dough and contributes to the preparation of spongy texture of bread crumb [29]. Achremowicz et al. [30] state that a gluten index above 95 is too hard, between 65-95 is suitable for baking purposes, while below 50 is too soft. On this basis, it can be concluded that in our studies, the gluten index of spring wheat cultivars (except for Cytra) was at the level appropriate for baking purposes. Sowing date and cultivar selection generally had a significant impact on the amount of wet gluten in all locations and years of research. The gluten index also significantly depended on the choice of cultivar in all localities, whereas in Czesławice and Bezek, also on the date of sowing. Cacak–Pietrzak [16] states that wheat flour, with the amount of wet gluten below 25%, should not be used in bakeries. Therefore, in order to ensure this level of gluten in the flour, the minimum amount of gluten in the grain should be about 27%. Cacak–Pietrzak et al. [1] and [31] consider that one of the main criteria for assessing the technological suitability of wheat grain is the assessment of protein and gluten content. According to [32], [33], changes in wet gluten content in spring and winter wheat grain depend on weather conditions in the years of research. Sunny weather with moderate rainfall and high temperature is the most favorable for the formation of large amounts of gluten proteins [34]. Weakening of the mechanical strength of gluten occurs due to thermal stress, when the synthesis of gliadin proteins is faster than that of gluten proteins [35].

The SDS sedimentation index is a parameter whose value depends on the quality and quantity of gluten. A higher value of the sedimentation index indicates a higher share of gluten proteins in the flour, especially of high molecular glutenin with exceptional swelling capacity and good baking value [36]. In our study, only in the case of wheat grain cultivated in Bezek, the earlier sowing date contributed to the lower SDS sedimentation index, while in the other location, this factor did not affect the value of this characteristic. It was observed that the value of the sedimentation index is a cultivar feature, which is confirmed by the results of the study conducted by [24], [37].

V. Conclusion

Analysis of qualitative parameters showed that the wheat

grain from the autumn and spring sowing dates was characterized by the similar falling numbers. The influence of the autumn term of sowing on the amount of wet gluten in grain was variable in years. In general, the grains obtained from autumn sowing date was characterized by the smaller amount of wet gluten than from spring sowing date, however its quality, measured by the gluten index, was higher. The effect of the sowing date on the SDS sedimentation index was depended on the location of the field experiment.

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Eng. M. Wyzińska (Dr.) In 2007, she graduated from the Faculty of Biology and Animal Breeding at the University of Life Sciences in Lublin. In 2017, she gained her PhD degree of Agricultural Sciences from the Institute of Soil Science and Plant Cultivation – State Research Institute (IUNG–PIB) in Puławy. She works as a research assistant at IUNG – PIB in Puławy. Her specialization is the cultivation of cereal plants.

J. Grabiński (Assoc. Prof.) In 1984, he graduated from the Faculty of Agriculture at the University of Life Sciences in Lublin. In 1994, he received the degree of Doctor of Agricultural Sciences in the field of agronomy at the Institute of Soil Science and Plant Cultivation – State Research Institute (IUNG–PIB) in Puławy, and in 2008 at the same Institute, the academic post-doctoral degree in Agricultural Sciences in the discipline of agronomy with the specialization of the soil and plant cultivation. Since 2010, he has been employed at IUNG–PIB in the Department of Cereal and Plant Production as an associate professor.

Alicja Sułek (Assoc. Prof.) She graduated from the Faculty of Agriculture at the University of Life Sciences in Lublin in 1982. In 1996, she gained her PhD degree of Agricultural Sciences in the field of agronomy from the Institute of Soil Science and Plant Cultivation – State Research Institute (IUNG–PIB) in Puławy. In 2014, she received her academic post-doctoral degree in Agricultural Sciences in the discipline of agronomy with the specialization of soil and plant cultivation. Since 1996, she has been employed at IUNG-PIB in the Department of Cereal and Plant Production as an assistant professor.