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ARTYKUŁ ORYGINALNY

Plonowanie odmian pszenżyta ozimego w warunkach klimatyczno-glebowych Wielkopolski

Yield of winter triticale cultivars in soil and climatic conditions of the Wielkopolska region in Poland

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Streszczenie

Od momentu przystąpienia Polski do struktur Unii Europejskiej regulacje prawne na poziomie unijnym pozwalają na wprowadzanie do obrotu odmian roślin zarejestrowanych w dowolnym kraju wspólnoty. W sezonach wegetacyjnych 2017–2019, w ramach Porejestrowego Doświadczalnictwa Odmianowego (PDO), w województwie wielkopolskim, oceniono cechy odmian pszenżyta ozimego, takie jak: wysokość roślin, wyleganie, porażenie przez choroby, plon i masę tysiąca ziaren. Dla rolników najważniejszym i najcenniejszym efektem badań prowadzonych w systemie PDO jest coroczna „Lista odmian zalecanych do uprawy na obszarze województwa". Głównym celem badań PDO jest pomoc rolnikom w trafnej selekcji/wyborze najwartościowszych odmian do uprawy, dostosowanych do lokalnych warunków. Badania tego typu dostarczają użytkownikom ciągłej informacji o wartości odmian dla uprawy i użytkowania, w tym o ich reakcji na różne czynniki agrotechniczne.

Słowa kluczowe: Porejestracyjne Doświadczalnictwo Odmianowe (PDO), pszenżyto ozime, rekomendacja odmian

Abstract

Since Poland has joined the structures of the European Union (EU), legal regulations at the EU level allow marketing of plant varieties registered in any country of the community. As part of the Post Registration Variety Trials (PRVT) in the Wielkopolska (Greater Poland) voivodeship, the analysis of the interaction of winter triticale cultivars for: height, lodging, diseases, yield and thousand kernel weight in growing seasons 2017–2019 was performed. For farmers, the most important and valuable effect of the research conducted in the PRVT system is the annual "List of varieties recommended for cultivation in the voivodeship". The main purpose of PRVT research is to help farmers in accurate selection/choice of the most valuable varieties for cultivation, adapted to local conditions. This type of research provides users with continuous information about the variety value for cultivation and use, including their reaction to various agrotechnical factors.

Key words: Post Registration Variety Trials (PRVT), winter triticale, variety recommendation

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Wstęp / Introduction

Field experiments in the system of Post Registration Variety Trials (PRVT) are directly aimed at the needs of agricultural practice. The main purpose of PRVT research is to help farmers to accurately select the most valuable varieties for cultivation, adapted to local conditions. The results obtained from a number of locations over a period of many years allowed to initiate the process of development of the "List of Recommended Varieties" for cultivation in a given voivodeship. These Lists contain from a few to over a dozen of varieties of a given crop species, which turned out to be the most valuable and most adapted to local farming conditions during at least two years of a field experiment in the voivodeship.

Breeders are provided with continuous information about variety value for cultivation and use, including their reaction to various agrotechnical factors, which facilitates the selection of appropriate varieties of the cultivated species (Gacek 1998; Gacek and Behnke 2006).

In hindsight, the assumptions and goals set by the founders of the Post Registration Variety Trials proved to be an excellent decision and preceded the currently introduced agricultural policy strategies of the European Union. The agricultural revolution that is taking place with the introduction of the European Commission's "European Green Deal" action plan, includes a reduction of the use of chemical plant protection in favour of, that naturally occurring in the plant world, genetic resistance (Gacek and Behnke 2006; Niedbała et al. 2022).

The research hypothesis of the study is an attempt to identify the winter triticale varieties best adapted to cultivation under the conditions of Wielkopolska. Well selected varieties are the basic and key recommendation for integrated pest management.

The aim of the research was to evaluate the yield of winter triticale cultivars in the soil and climatic conditions of Greater Poland (Wielkopolska) Region. Strict field experiments with winter triticale varieties, in terms of their suitability for cultivation, were carried out at Agricultural Experimental Station Winna Góra, Institute of Plant Protection – National Research Institute (IPP – NRI) in vegetation seasons 2017–2019.

Materiały i metody / Materials and methods

The plant material for research comprised of winter triticale cultivars accepted for research within the framework of Post Registration Variety Trials (PRVT) at the Institute of Plant Protection – National Research Institute (IPP – NRI) Agricultural Experimental Station Winna Góra (52°12′17″N, 17°26′48″E), Greater Poland (Wielkopolska) region. The experiments were carried out in 16.5 m^2 plots with two replicates, in a completely randomized design. The field experiments were carried out during 2017–2019 growing seasons. Twenty varieties of winter triticale were used for the study in growing seasons 2017 and 2018 and twenty-two in 2019, fifteen of which were tested over a three-year period (tab. 2). The forecrops in the study years were winter wheat (2017, 2018) and spring barley (2019). Sowing, fertilisation and harvesting dates are shown in table 1. Sowing depth: 3–4 cm, row spacing: 10.5 cm. The features (height, lodging, powdery mildew, brown rust, septoria leaf spot, septoria glume bloth, leaf bloth, fusarium diseases – ears, stem base disease, yield, thousand kernel weight) of winter triticale cultivars were analyzed at two agrotechnic levels: a1 and a2 (a1 – standard level, a2 – intensive level, where increased fertilization by 40 kg N and increased chemical protection were used).

During the study years, the environmental conditions (precipitation, air temperature) were also analysed (fig. 1–3).

The normality of the distributions for the studied traits (height, lodging, powdery mildew, brown rust, septoria leaf spot, septoria glume bloth, leaf bloth, fusarium diseases – ears, stem base disease, yield, thousand kernel weight) was tested using Shapiro-Wilk's normality test (Shapiro and Wilk 1965). Next, three-way analyses of variance (ANOVA) were carried out to determine the effects of year, cultivar and level of technology as well as all interactions on the variability of examined traits, for each trait independently. The arithmetical means of yield and thousand kernel weight were calculated. The analysis of the relationship between yield, thousand kernel weight and selected traits was carried out with multivariate regression analysis. Observations from each year (2017, 2018, 2019) and each level of technology used (a1, a2) were analyzed separately.

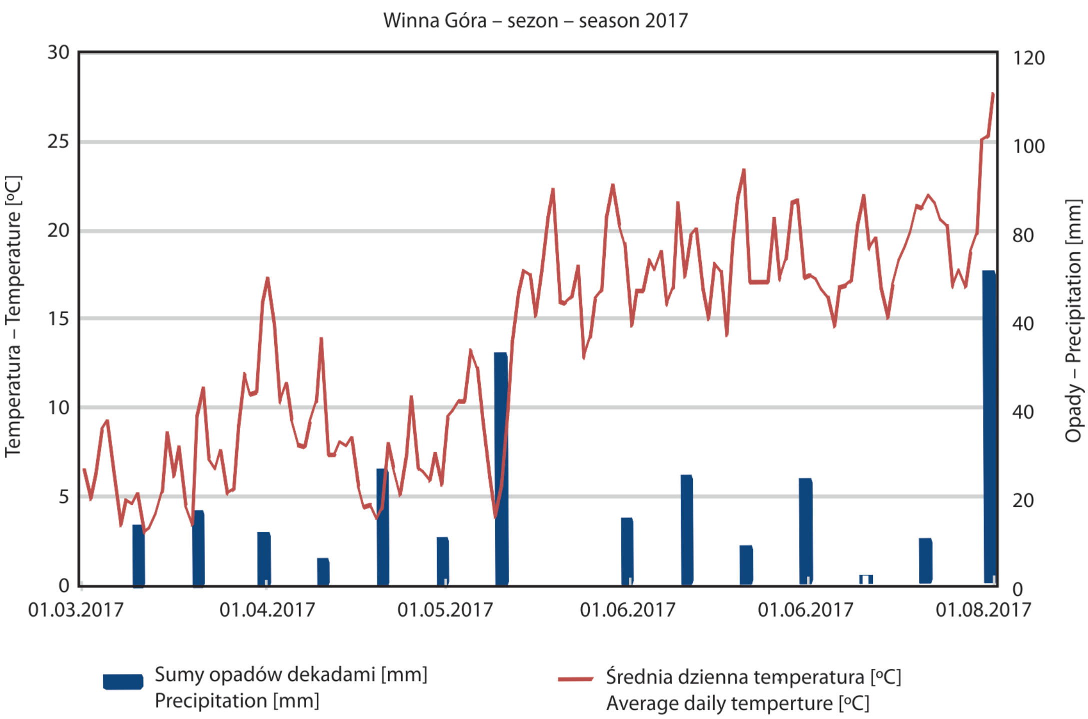
The calculations were carried out using the statistical package GenStat 18th edition (VSN International) and in R version 3.6.2.

Wyniki i dyskusja / Results and discussion

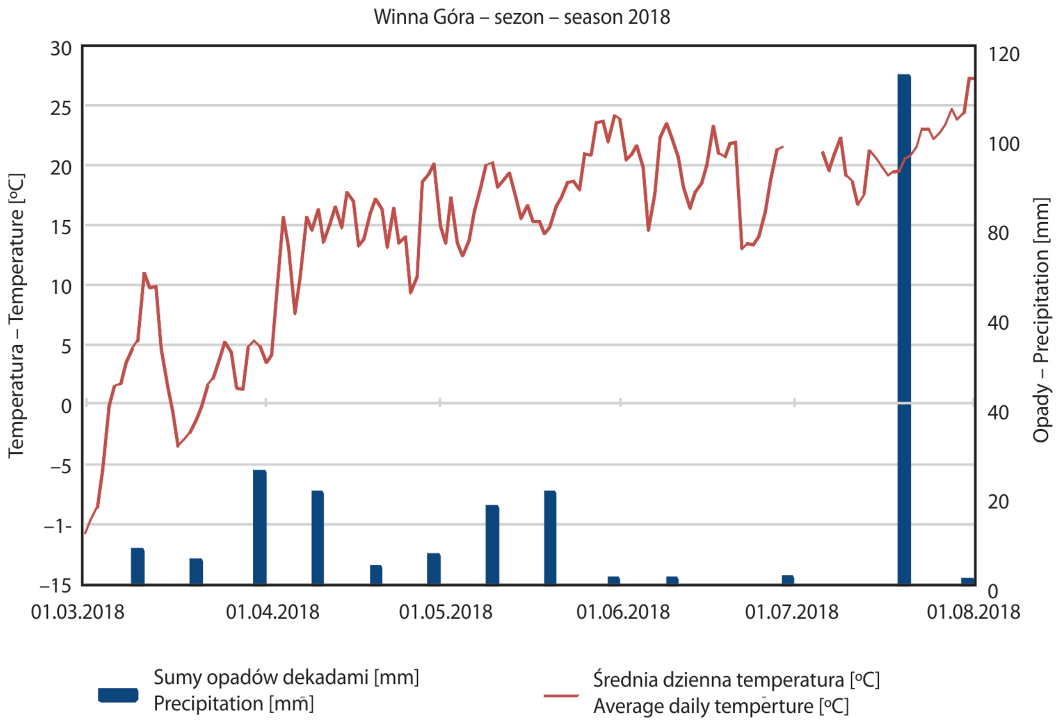
Results of analysis of variance showed that the effect of the year determined all observed traits except lodging (tab. 1). Statistical significant differences between levels of technology were observed for all traits except lodging and fusarium diseases – ears. Effect of the cultivar determined height, yield and thousand kernel weight. Cultivar-by-level of technology and year-by-cultivar-by-level of technology interaction were not significant for all 11 traits (tab. 1).

Warunki pogodowe / Weather conditions

The 2017 growing season recorded moderately good meteorological conditions for plant development, especially in terms of temperature. The period of April, May, when

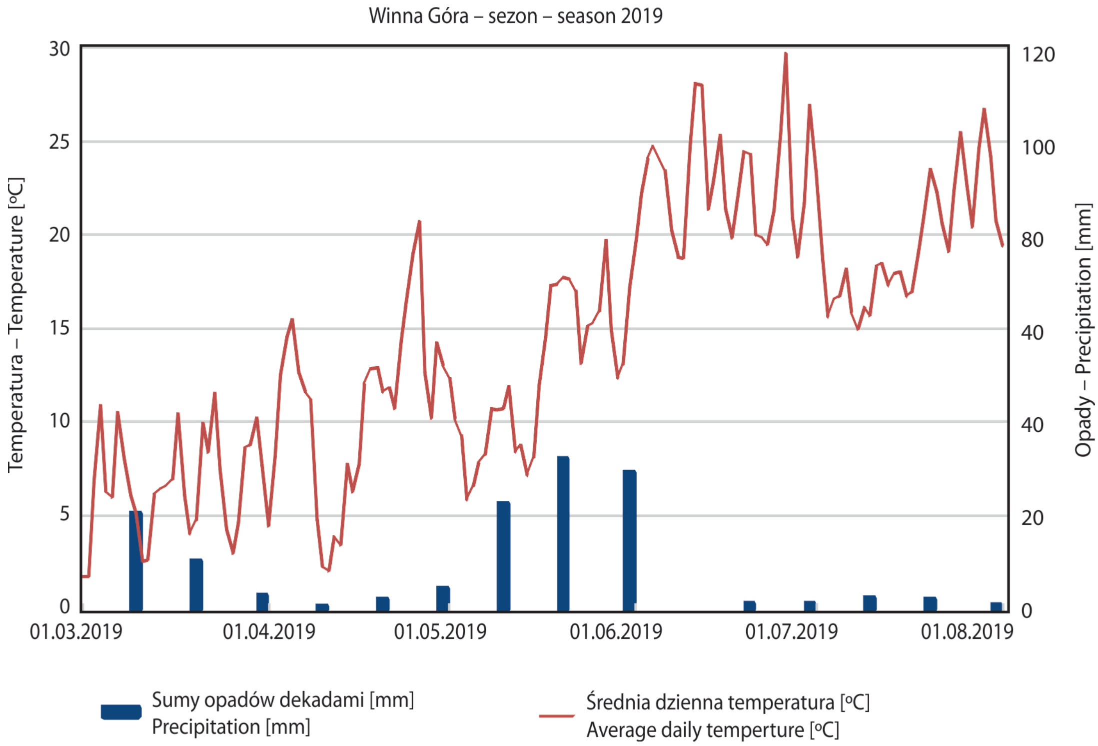


Rys. 1. Warunki meteorologiczne w sezonie wegetacyjnym 2017
Fig. 1. Meteorological conditions during the 2017 growing season



Rys. 2. Warunki meteorologiczne w sezonie wegetacyjnym 2018
Fig. 2. Meteorological conditions during the 2018 growing season

triticale develops intensively, was rather cool (daily average did not exceed 17°C). The other months recorded slightly higher temperatures. The distribution of precipitation was also moderate (fig. 1).



Rys. 3. Warunki meteorologiczne w sezonie wegetacyjnym 2019
Fig. 3. Meteorological conditions during the 2019 growing season

Tabela 1. Daty siewów, nawożenia i zbiorów w sezonach wegetacyjnych
Table 1. Sowing dates, fertilization and dates of harvest in vegetation seasons

Sezon Season	Data siewu Sowing date	Nawożenie – Fertilization		Data zbioru Date of harvest
		a1	a2	
2017	24.10.2016	26.09.2016 – P_2O_5, K_2O, N* 06.03.2017 – N*	26.09.2016 – P_2O_5, K_2O, N* 06.03.2017 – N* 12.04.2017 – N**	28.07.2017
2018	29.09.2017	27.09.2017 – P_2O_5, K_2O, N* 10.03.2018 – N*	27.09.2017 – P_2O_5, K_2O, N* 10.03.2018 – N* 18.04.2018 – N**	23.07.2018
2019	29.09.2018	25.09.2018 – P_2O_5, K_2O, N* 08.03.2019 – N*	25.09.2018 – P_2O_5, K_2O, N* 08.03.2019 – N* 14.04.2019 – N**	25.07.2019

Dawki stosowania czystego składnika nawozu: – Application rates of the pure fertilizer component:
P – 45 kg/ha, K – 128 kg/ha, N* – 16 kg/ha, N** – 60 kg/ha

The year 2018, in which the highest (average) yields of winter triticale varieties were obtained, was characterized by favorable temperatures, with a daily average of 10–20°C from mid-April to the end of July, but lower rainfall was recorded than in 2017, especially in May (fig. 2).

In 2019, low precipitation was also recorded between April and May, with trace precipitation. The temperature distribution was favourable between April and June (fig. 3).

In summary, the winter triticale varieties tested showed good adaptation to the prevailing agrotechnical conditions (fertilization, chemical protection), despite not very favorable moisture relations during the study years, yields were at a high level.

Plon / Yield

In the first year of study (2017), the yields of winter triticale varieties at the a1 level ranged from 6.855 t/ha for variety Trismart to 8.654 t/ha for variety Kasyno. At the a2 level yields were higher than at the a1 level. Variety Borowik showed the lowest yielding (7.54 t/ha), while the highest yield was found in cultivar Rotondo (9.275 t/ha). The second year of study (2018) was the most favourable for winter triticale cultivars in terms of yield. At the a1 level, the yields ranged from 7.22 t/ha for Octavio variety to even 13.15 t/ha for Orinoco variety. At the intensive level of a2, the yields ranged from 11.33 t/ha for variety Lombardo to 15.62 t/ha for the cultivars Sekret and Tadeus. In the third year of the research (2019), at the a1 level, the lowest yielding was shown for the Trefl variety (7.855 t/ha), and the highest Avocado (10.505 t/ha). At the a2 level, the yields ranged from 7.755 t/ha (for Toro) to 11.205 t/ha for Panteon (tab. 2).

Masa tysiąca nasion (MTS) / Thousand kernel weight (TKW)

In the first year of study (2017), TKW at the a1 level ranged from 11.31 g for variety Trismart to 14.27 g for variety Kasyno. At level a2, the lowest TKW showed variety Borowik (12.03 g), while the highest – variety Rotondo (15.31 g). The second year of the research (2018), was the most favourable year for winter triticale cultivars in terms of TKW and yield. At the a1 level, TKW ranged from 35.58 g for variety Trapero to 53.09 g for variety Orinoko. At the a2 level, TKW ranged from 36.27 g for variety Meloman to 52.69 g for variety Borowik. In the third year of research, at the a1 level, the lowest TKW was observed in Trefl (12.71 g), and the highest by Tadeus (16.3 g). At the a2 level, TKW value ranged from 12.57 g (Toro) to 16.16 g for Panteon (tab. 2).

Związki między obserwowanymi cechami / Relationships between observed traits

Results for a relationship between yield and traits in 2017: level of technology a1 shows negative influence for brown rust, septoria leaf spot, septoria glume blotch, stem base disease and positive for powdery mildew and fusarium diseases on yield. For a2 level of technology – brown rust, septoria glume blotch had a negative influence on yield and powdery mildew, septoria leaf spot, fusarium ear blight – positive (tab. 3). In 2018 a1 negative impact on yield was observed for powdery mildew, brown rust, and positive for septoria leaf spot, septoria glume blotch, fusarium ear blight, stem base disease. For a2, the negative influence shows powdery mildew, septoria leaf spot, septoria glume blotch, and positive brown rust, fusarium diseases and stem base disease (tab. 3). In 2019 observations for a1 level of technology, powdery mildew, brown rust, and septoria leaf spot had a positive effect on yield where septoria glume blotch had a negative influence. For a2 level of technology powdery mildew and brown rust influence was positive and sep-

Tabela 2. Średnie kwadraty z trójczynnikowej analizy wariancji dla obserwowanych cech
Table 2. Mean squares from three-way analysis of variance for observed traits

Źródło zmienności Source of variation	Rok, R Year, Y	Odmiana, O Cultivar, C	Poziom agrotechniki, PA Level of technology, L	R O Y C	R PA Y L	O PA C L	R O PA Y C L	Błąd Residual
d.f.	2	26	1	33	2	26	33	124
Wysokość Height	2761.69 ***	401.94 ***	2580.65 ***	332.26 ***	988.24 ***	35.98	38.79	42.08
Wyleganie Lodging	0.0147	0.0061	0.0161	0.0090	0.0147	0.006	0.0090	0.008
Mączniak prawdziwy Powdery mildew	5.8644 ***	0.5119	33.3911 ***	0.3543	2.1152 **	0.4989	0.4442	0.4073
Rdza brunatna Brown rust	2.8838 ***	0.5014	17.5645 ***	0.396	0.9842	0.253	0.2239	0.379
Septorioza liści Septoria leaf spot	9.2741 ***	0.2249	22.0806 ***	0.1962	5.7483 ***	0.2495	0.2556	0.3145
Septorioza plew Septoria glume bloth	31.6124 ***	0.118	11.3266 ***	0.1159	10.6179 ***	0.1206	0.1076	0.1653
Rynchosporioza Leaf bloth	16.9274 ***	0.0711	1.4556 *	0.1699	1.3262 *	0.0782	0.1245	0.3024
Fuzariozy kłosów Fusarium diseases – ears	1.3607 ***	0.1005	0.004	0.0916	0.0042	0.0576	0.0679	0.1331
Choroby podstawy źdźbła Stem base disease	3.5006 ***	0.1396	8.1653 ***	0.1643	0.3418	0.1104	0.1676	0.1815
Plon Yield	487.575 ***	3.035 **	62.712 ***	4.036 ***	30.554 ***	0.721	0.837	1.335
Masa tysiąca ziaren Thousand kernel weight	22861.682 ***	19.085 ***	43.756 *	19.761 ***	10.638	7.806	6.928	6.532

*P < 0.05; **P < 0.01; ***P < 0.001; d.f. – liczba stopni swobody – the number of degrees of freedom toria leaf spot, septoria glume blotch and lodging – negative (tab. 3).

Results of regression analysis in 2018: a1 level of technology shows significant negative influence of powdery mildew and brown rust on thousand kernel weight (tab. 4). Septoria glume blotch and fusarium ear blight effect were also negative. The positive influence was observed only in septoria leaf spot and stem base disease. For a2 in 2018, negative impact shows: powdery mildew, septoria leaf spot, fusarium ear blight, where brown rust, septoria glume blotch, stem base disease had a positive influence (tab. 4). In 2019, a1 level of technology shows a significant positive effect on thousand kernel weight had brown rust. Also, the positive impact had powdery mildew and septoria leaf spot. A negative effect was observed in septoria glume blotch, and stem base disease (tab. 4). In a2 level of technology, a positive effect was also observed in powdery mildew and brown rust. Negative influence on thousand kernel weight had septoria leaf spot, septoria glume blotch, and lodging (tab. 5).

Tabela 3. Średnie wartości dla plonu [t/ha] i masy tysiąca ziaren [g] odmian pszenżyta ozimego badanych na dwóch poziomach agrotechniki

Table 3. Mean values for yield [t/ha] and thousand kernel weight [g] for studied cultivars in particular years of observations and for two levels of technology

Rok badań Year	Plon – Yield [t/ha]						Masa tysiąca ziaren – Thousand kernel weight [g]					
	2017		2018		2019		2017		2018		2019	
Poziom agrotechniki Level of technology	a1	a2	a1	a2	a1	a2	a1	a2	a1	a2	a1	a2
Avokado	8.15	9.11	13.04	13.44	10.51	9.52	13.45	15.02	45.49	44.75	14.03	15.46
Belcanto	–	–	–	–	9.77	9.71	–	–	–	–	15.82	15.73
Borowik	7.22	7.29	11.54	14.17	9.03	9.36	11.91	12.03	47.26	52.69	14.64	15.20
Camelo	–	–	12.96	14.99	8.95	8.85	–	–	48.50	51.25	14.53	14.30
Festino	8.06	7.94	–	–	–	–	13.30	13.10	–	–	–	–
Fredro	8.02	8.71	11.49	14.26	8.34	8.40	13.24	14.37	40.05	44.23	13.51	13.65
Kasyno	8.65	8.08	12.62	13.86	8.39	9.13	14.27	13.34	48.72	43.61	13.57	14.79
Lombardo	7.77	8.76	10.48	11.33	8.46	9.18	12.81	14.45	42.15	41.98	13.75	14.87
Maestozo	7.36	8.22	9.28	12.71	8.38	8.85	12.14	13.56	39.64	42.13	13.59	14.34
Meloman	8.22	9.22	12.93	13.96	9.44	8.77	13.56	15.21	42.95	36.27	15.30	14.21
Octavio	–	–	7.23	11.42	8.57	9.81	–	–	36.33	37.37	13.89	13.08
Orinoko	–	–	13.15	14.90	8.70	8.09	–	–	53.09	43.26	14.09	13.09
Panteon	7.80	7.43	10.89	12.60	8.41	11.21	12.87	12.26	38.95	43.90	13.63	16.16
Pigmej	8.34	8.48	–	–	–	–	13.76	13.99	–	–	–	–
Pizarro	7.92	8.64	–	–	–	–	13.06	14.26	–	–	–	–
Porto	–	–	8.77	12.68	8.94	9.24	–	–	37.80	41.95	14.52	14.98
Rotondo	8.27	9.28	11.88	15.40	8.24	7.85	13.63	15.31	38.52	43.37	13.37	12.73
Rufus	7.10	7.70	11.95	14.76	8.96	8.40	11.71	12.70	39.75	40.12	14.54	13.61
Sekret	7.40	8.97	14.29	15.62	8.31	8.19	12.21	14.80	41.84	46.22	13.48	13.29
Subito	8.45	8.80	8.84	12.09	8.43	9.22	13.93	14.52	41.31	46.17	13.63	14.96
Tadeus	–	–	12.45	15.62	10.04	9.18	–	–	46.66	45.25	16.30	14.86
Temuco	8.40	8.73	11.41	15.00	8.71	9.33	13.85	14.40	38.17	40.93	14.12	15.12
Torino	7.40	8.13	–	–	–	–	12.21	13.41	–	–	–	–
Toro	–	–	–	–	9.02	7.76	–	–	–	–	14.60	12.57
Trapero	7.45	7.58	12.33	14.45	9.40	8.85	12.28	12.51	35.58	40.67	15.23	14.32
Trefl	8.24	8.60	12.73	15.48	7.86	8.99	13.59	14.19	39.70	47.53	12.71	14.55
Trismart	6.86	8.22	–	–	–	–	11.31	13.55	–	–	–	–

The aims and objectives of agricultural policies implemented by the European Union (EU), the agricultural revolution which has been initiated with the adoption of the European Green Deal action plan by the European Commission, the Farm to Fork strategy, and the EU Biodiversity strategy assume reduction in the use of chemical plant protection and stronger reliance on the natural genetically-determined resistance of plants. According to the above-mentioned strategies adopted by the European Commission on 20 May 2020, Member States are obliged to reduce by 50% the use of chemical pesticides by 2030, through the utilization of biological methods and crop varieties resistant/tolerant to pathogens. In this context, the use and availability of resistant varieties is crucial for the breeding and production of crops (EC 2011; FAO UN 2014; MRiRW 2018).

In view of the above, the results of research conducted as part of Post Registration Variety Trials (PRVT) take on a particularly important and essential element of planning the plant production strategy on farms (Przystalski et al. 2008).

Poland is a country with a high variability of climatic and soil conditions, which means that its area is diverse in terms of the possibility of obtaining a high yield of arable crops. In the structure of crops in Poland, cereals are at the forefront, accounting for about 77% of the acreage, and their profitability affects the overall economic situation of agriculture. In the EU, we are third in terms of cereal sown area, and in the world first in the production of triticale. The most important advantage of triticale is relatively low soil and climate requirements, quite good resistance to diseases and lodging, and satisfactory yielding. In addition, triticale is widely recognized as an excellent feed grain (Chełkowski et al. 2000; Achremowicz et al. 2014). The growing interest in triticale and the ever-expanding selection of new, improved varieties, often aimed at specific use in the food or feed industry, requires an effort of research confirming their usefulness (Cyfert 2008; Tratwal and Bocianowski 2021).

The main objective of the implementation of PRVT in a practical context is to maintain an effective inflow of information about the economic and use-value of varieties and their recommendations to various management systems. At the planning stage, today's farmer should take into account a specific variety for a specific direction of use, both to the conditions of the environment and the level of agrotechnics (Bocianowski et al. 2021). The constant development of the PRVT research system and the wide evaluation of registered varieties significantly help in making the right choice. Such experiments are a valuable source of information for farmers in terms of the selection of varieties for cultivation (Bujak et al. 2012a, 2012b, 2013).

Post Registration Variety Trials is a system of permanent or periodic research of the economic value of varieties of cultivated plant species of high economic importance, enclosed in the National List (NL) or in Common Catalogue of Varieties of Agricultural Plant Species (CCA).

Tabela 4. Wyniki analizy regresji pomiędzy wybranymi cechami a plonem dla każdego roku i poziomu technologii
Table 4. Results of regression analysis between selected traits and yield for each year and level of technology separately

Rok badań – Year	2017		2018		2019	
Poziom agrotechniki Level of technology	a1	a2	a1	a2	a1	a2
Stała Constant	12.74*	4.87	–0.79	16.21	8.96	16.68
Mączniak prawdziwy Powdery mildew	0.24	0.03	–0.34	–0.01	0.23	0.15
Rdza brunatna Brown rust	–0.16	–0.02	–0.42	0.51	0.51	0.52
Septorioza liści Septoria leaf spot	–0.02	0.62	0.84	–0.41	0.25	–0.08
Septorioza plew Septoria glume blotch	–0.53	–0.3	0.45	–1.04	–0.67	–0.19
Rynchosporioza Scald	–0.18	–0.37	–0.67	–0.31	–0.19	–0.67
Fuzariozy kłosów Fusarium ear blight	0.21	0.53	0.54	0.62	–	–
Choroby podstawy źdźbła Stem base disease	–0.1	–	1.18	0.28	–	–
Wyleganie Lodging	–	–	–	–	–	–0.54

*$P < 0.05$

Tabela 5. Wyniki analizy regresji pomiędzy wybranymi cechami a masą tysiąca ziaren dla każdego roku i poziomu technologii
Table 5. Results of regression analysis between selected traits and thousand kernel weight for each year and level of technology separately

Rok badań – Year	2018		2019	
Poziom agrotechniki Level of technology	a1	a2	a1	a2
Stała Constant	93.14*	42.62	19.95	46.85*
Mączniak prawdziwy Powdery mildew	–3.78**	–0.38	0.18	0.25
Rdza brunatna Brown rust	–2.49*	1.5	1.02*	0.59
Septorioza liści Septoria leaf spot	1.55	–1.58	0.27	–0.86
Septorioza plew Septoria glume blotch	–1.97	0.66	–1.58	–1.19
Rynchosporioza Scald	–0.74	1.06	–0.16	–1.27
Fuzariozy kłosów Fusarium ear blight	–0.36	–2.03	–0.2	–
Choroby podstawy źdźbła Stem base disease	0.98	0.84	–	–1.16
Wyleganie Lodging	–	–	–	–

*P < 0.05; **P < 0.01

Basic benefits of implementing the PRVT system included: (1) effective use of biological progress in agriculture, (2) systematic inflow of objective information about the use-value of varieties, both in the country and in different regions of the country, as well as about different cultivation conditions, and (3) making it easier for farmers to make the right choice for the cultivation of the most valuable varieties from NL and CCA, adapted to local farming conditions. In conclusion, in the first year of study (2017), the yields of winter triticale varieties at the a1 level ranged from 6.855 t/ha to 8.654 t/ha. At the a2 level yields were higher than at the a1 level reaching values from 7.54 t/ha to 9.275 t/ha. The second year of study (2018) was the most favorable for winter triticale cultivars in terms of yield (a1 level, the yields ranged from 7.22 t/ha to 13.15 t/ha at the intensive level a2 from 11.33 t/ha to 15.62 t/ha). In the third year of the research (2019), at the a1 level, yielding ranged from 7.855 t/ha to 10.505 t/ha, while at the a2 level from 7.755 t/ha to 11.205 t/ha for Pantheon.

Wnioski / Conclusions

1. Research conducted under the Post Registration Variety Trials (PRVT) system makes it possible to identify the varieties best adapted to the local conditions of a given region.
2. The selection of appropriate, adapted varieties with adequate disease resistance and good yield is one of the basic requirements of integrated control.
3. In the second vegetation season, 2018, the best yield of the tested varieties was obtained.
4. The highest yield increase, in 2018, compared to the other years of the study, was obtained for the varieties Borowik, Fredro, Rufus, Sekret, Temuco, Trapero, Trefl, which can be recommended for cultivation in the region of Wielkopolska.

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