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BORDER EFFECTS IN THE GROWTH OF CHOSEN CULTIVATED PLANT SPECIES

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Abstract. Greater vigour of plants that border with unsown areas, known as border effect, compensates for the use of tramlines in the lowland meadow but also gives an error to the results of field experiments. This phenomenon is well-known for certain cultivated plant species. However, there is a lack of publications which would make it possible to analyze and compare the border effect of several plant species in similar habitat conditions and evaluated in the same way. The aim of the study was to recognize and compare the border effect in the cultivation of spring cereals: wheat, triticale, barley, oat, pea, and yellow lupine, as well as to determine the effect of this phenomenon on yield overestimation in plot experiments. In years 2004-2010 at the University of Technology and Life Sciences Research Station at Mochełek (53°13' N; 17°51' E), a series of plot experiments was carried our, each according to the same methodology. Experimental factor was the situation of plant rows on the plot; four rows into the plots from the unsown path 50 cm wide were evaluated. It was found that the border effect resulted in greater values of nearly all the evaluated plant characteristics. Oat was the most susceptible to the effect. Border effect in cereals, in relation to most characteristics, was limited only to the row of plants directly adjacent to the path, while in the subsequent two rows the values of the particular characteristics were usually close to the evaluation of the fourth row. In the case of legumes, the effect was visible also in the subsequent two rows into the lowland meadow. Yields of plants harvested from the whole plot were greater by 18.3%-28.0% than in the mid area of the plot, depending on the plot area and plant species. It was also found that in order to avoid the border effect influencing yield size estimation, it is recommended to omit during harvest one border row of oat plants from both sides of the experimental plots and two rows of triticale and barley. In the case of wheat, lupine and pea, three rows of plants from each side of the plot should be excluded from harvest.

Key words: border row, experimental error, legumes, spring cereals

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INTRODUCTION

In the lowland meadows of cultivated plants, strong intra- and interspecies interactions occur, mainly of competitive nature [Sobkowicz 2003, Michalska *et al*. 2008]. Border effect takes place when plants border directly with areas not covered by other plants. In field production, it occurs on the edges of fields or along tramlines, and in experiments at the edges of experimental units separated by paths [Pacewicz 2000, Stawiana-Kosiorek *et al*. 2007]. Border effect may also to a large extent compensate for yield decrease that results form the presence of unsown tramlines in the lowland meadow [Niemczyk 2004, Niemczyk and Buliński 2012]. Lack of potential competition in uncovered areas increases the availability of limited habitat supplies for plants that neighbour with them. As a result, those plants have more vigorous vegetative and generative organs [Rudnicki and Gałęzewski 2006, 2008a, b, c].

Influence of the border effect depends on many factors. Response of every species is different and depends on: path width, sowing density, path orientation in regards to cardinal directions, as well as weather conditions. The wider the path that separates the plots, the greater the effect [Rudnicki and Gałęzewski 2008a, b, c]. As sowing density decreases, intraspecies competition decreases. Single specimens in the lowland meadow possess greater access to habitat resources, and the influence of border effect is lower. On the other hand, in dry conditions border effect increases [Rudnicki and Gałęzewski 2006].

Results of the hitherto existing research on the border effect usually relate to one or two species included in the same study method. However, there is a lack of works that make it possible to analyze and compare this phenomenon in many different plant species in similar habitat conditions and evaluated in the same way. This would make it possible to verify the hypothesis on the diversified possibilities of compensation for the unsown areas in the lowland meadow depending on plant biology and agrotechnics and on the influence of border effect on the precision of field experiments.

The aim of the study was to recognize and compare the border effect in the cultivation of spring cereals: wheat, triticale, barley, oat, pea, and yellow lupine, as well as to determine the effect of this phenomenon on yield overestimation in plot experiment.

MATERIAL AND METHODS

Source material was the results of six multiple, one-factor plot experiments, whose aim was to determine the border effect in six crop species. The experiments were carried out at the Research Station of the Department of Agriculture and Biotechnology at Mochełek (53^{o}13’ N; 17^{o}51’ E), which is part of the University of Technology and Plant Sciences in Bydgoszcz, according to common methodology, in years 2004-2010 (Table 1). Each experiment was set up as a random block design in six repetitions. One repetition was made up of two respective rows on both sides of the plot (for example first, second etc. rows from the path). Plots were 150 cm wide and were composed of 12 plant rows at the spacing of 12.5 cm. The experimental factor was the situation of plant row on the plot, that is four rows from the path into the plot. The experimental unit was subsequent plant rows four meters of length each. The path that separated the plot was 50 cm wide. Sowing was done manually and the plots were situated with the longer side in the north-south direction. Species choice and sowing density are presented in Table 1.

Table 1. Research years, species choice, and plant sowing density for the particular species

Species	Research years		Cultivar	Sowing density plant·running m^{-1}
	period	number		
Yellow lupine	2005-2010	6	Lidar	20
Pea	2008-2010	3	Ramrod	20
Spring wheat	2008-2010	3	Bombona	90
Spring triticale	2006-2010	5	Dublet	90
Spring barley	2008-2010	3	Antek	60
Oat	2004-2007	4	Hetman	90

All the species were sown on one date. Depending on the year, the sowings were conducted between March 26th and April 5th. The experiments were set up on IVa-IVb soil after winter rapeseed. During spring, 70 kg $P_2O_5 \cdot ha^{-1}$, 80 kg $K_2O \cdot ha^{-1}$, and 34 kg $N \cdot ha^{-1}$ were applied into the soil. Top-dressing with nitrogen was applied only in cereals at the dose of 34 kg $N \cdot ha^{-1}$ during tillering.

After the emergence, plant density of every species was evaluated in the entire rows. Analogically, the evaluation of lupine and pea density and straws with cereal syncarps was carried out before harvest. Harvest was done manually, separately from each row. All the plants of a given species collected from the entire rows were used for the assessment of biometrical characteristics included in the Results.

For the statistical analysis of the data from single experiments, analysis of variance was used in the model that was proper for random block design with the Tukey's test. The analysis of multiple experiments was carried out by the estimation of F, calculated on the basis of the estimation error increased by the interaction of factor with years. Packet of statistical programs ANALWAR-5.2-FR was used. Border effect index (EB) was calculated as the quotient of seed (grain) mass of the plants that occurred respectively in one of three first rows from the unsown area (path) and the fourth row:

$$EB = \frac{R_{(1,2,3)}}{R_{(4)}} \tag{1}$$

where:

$R_{(1,2,3)}$ – seed (grain) mass of the plants in rows 1. or 2. or 3.,
$R_{(4)}$ – seed (grain) mass of the plants in row 4.

Assessment of the degree of yield overestimation in the experiment (Z) was carried out on the basis of the comparison of yield from the entire plot area and yield from its mid part, where no border effect is observed, according to the formula described by Rudnicki and Gałęzewski [2008c]:

$$Z = 100 \cdot \frac{(P_s \cdot W_s) + (P_b \cdot W_b)}{P_s \cdot (W_s + W_b)} - 100 \ [\%] \tag{2}$$

where:

P_s – mass of plants or their organs in the row in the mid part of the plot [g],
P_b – mass of plants or their organs in the row adjacent to the path [g],
W_b – area of the part of the plot with border effect $W_b = 2 \cdot (D + S) \cdot S_m)$ [m^2],

W_s – area of the mid part of the plot, with no border effect
$W_s = (D \cdot S) - W_b)$ [m^2],
D – plot length [m],
S – plot width [m],
S_m – row separation [m].

This formula is legitimate with the assumption that the border effect occurs only in the first row of plants (at the plot circumference), next to the path and when the border effect index for plants that grow at the front of the plot (on the shorter side) has the same value as the one along the side path (along the rows). Furthermore, overestimation that results from decreasing plot width for the subsequent plant rows is not taken into account.

In order to take into account greater reach of the border effect, including also second and third plant rows, the formula was modified within the range of the area of the plot part where the border effect occurs (W_b), respectively:

$$W_{b2} = 4 \cdot (D + S) \cdot S_m \text{ i } W_{b3} = 6 \cdot (D + S) \cdot S_m \quad (3)$$

The degree of yield overestimation in the experiment (Z) was therefore calculated alternatively, taking into consideration border effect only in relation to the first row, as well as jointly two and three rows into the plot. In order to establish the parameter (P_b), average grain or seed mass from those rows was then taken into account. Calculations were done for different plot areas, assuming the width of 1.5 m, but diverse length.

RESULTS AND DISCUSSION

Values of many biometric characteristics and yield elements studied in the six plant species depended on their location in the particular rows on the plot (Table 2), which confirms the occurrence of the border effect. Only the mass of 1000 grains of wheat, triticale and oat, as well as the height of barley plants were not subject to that effect. In the hitherto existing studies, the occurrence of border effect was found in the cultivation of many plants, for example rapeseed [Niemczyk 2009], potato [Niemczyk 2011], sugar beet [Niemczyk 2004], triticale [Stawiana-Kosiorek *et al*. 2007], oat [Rudnicki and Gałęzewski 2006], wheat and barley [Pacewicz 2000], pea [Stawiana-Kosiorek *et al*. 2003], and yellow lupine [Rudnicki and Gałęzewski 2008a,b,c]. This confirms the universality of this phenomenon, which relates to the diversification of plant morphology and yield depending on plant position against unsown areas.

In the present studies, the number of pea plants before harvest in the fourth row from the path amounted to 11.2 plants, which indicates that nearly half of the plants got out of the growth (Table 3). The plants sown in the border row in the same number of 20 plants were characterized by higher survivability. Their number before harvest was 73.5% of the original number, and border effect occurred only in the first row. Higher, although decreasing towards the edge of the plot was the loss of yellow lupine plants. The lowest straw mass of both pea and lupine was obtained in the fourth row, that is in the middle of the lowland meadow. Straw mass from the subsequent rows increased with approaching the edge of the plot. In pea, the border effect for this characteristic was strongly marked only in the first row, adjacent to the path that divided the plots. In the case of lupine, the effect in the first row was smaller than in pea but reached deeper, up to the third row. Likewise, depending on the row location within the experimental plot, generative traits in both legume species were shaped. Increase in the size of those characteristics in pea in the row adjacent to the path reached from 5.4% – mass of 1000 grains to 85.7% – mass of pods, in comparison with the plants in the fourth row. The differences in rows 2. and 3. in relation to the fourth row were smaller or were only a tendency. Yellow lupine plants in the row adjacent to the path formed greater pod mass and number per plant, and in the pods they had bigger seeds than in the rows farther from the path. For those characteristics, the border effect reached the second or even third row into the plots.

Table 2. Significance of the border effect in relation to the chosen plant characteristics of the studied species

Species	Straw height	Number of plants, spikes or panicles per row	Number of seeds/grains per pod/ syncarp of cereals	Mass of 1000 seeds/grains	Mass of seeds/grains from the row	Mass of straw from the row
Yellow lupine	–	**	**	**	**	**
Pea	–	**	**	**	**	**
Spring wheat	**	**	**	ns	**	**
Spring triticale	*	**	**	ns	**	**
Spring barley	ns	**	**	**	**	**
Oat	**	**	**	ns	**	**

** significance at P = 0.01; * significance at P = 0.05
ns – non-significant
– no evaluation

Table 3. Effect of plant row on the plot on the chosen characteristics of pea and yellow lupine

Characteristic	Unit	Row from the path				LSD
		1	2	3	4	
Pea						
Plant number	plant·running m^{-1}	14.7	11.8	11.3	11.2	0.76
Straw mass	g·running $meter^{-1}$	116.1	79.0	72.2	66.0	14.28
Pod mass	g·running $meter^{-1}$	80.4	57.6	49.2	43.3	12.76
Pod number	pod·$plant^{-1}$	5.26	3.97	3.94	3.95	0.50
Mass of 1 pod	g	0.91	0.97	0.88	0.83	0.11
Number of grains per pod	grain	3.74	3.50	3.48	3.33	0.09
Mass of 1000 seeds	g	214	210	207	203	3.90
Yellow lupine						
Plant number	plant·running $meter^{-1}$	8.89	8.45	8.35	7.81	0.26
Straw mass	g·running $meter^{-1}$	80.4	65.7	59.2	51.2	6.83
Pod mass	g·running $meter^{-1}$	69.3	52.4	42.1	36.7	6.20
Pod number	pod·$plant^{-1}$	9.16	7.28	6.01	5.80	0.84
Mass of 1 pod	g	0.88	0.90	0.85	0.83	0.05
Number of grains per pod	grain	3.98	3.83	3.54	3.44	0.15
Mass of 1000 seeds	g	129	127	125	121	2.99

The highest border effect in cereals that grow in the rows adjacent to unsown areas was observed for plant height, particularly in oat and wheat. Those plants in the first rows from the path had higher straws by, respectively, 7.9 cm and 7.3 cm than in the fourth row (Table 4). Border effect in those species in relation to plant height was visible only in the row directly adjacent to the path. On the other hand, in triticale it reached the second row, and in spring barley it did not occur.

Table 4. Effect of plant row on the plot on the chosen characteristics of spring cereals

Characteristic	Unit	Row from the path				LSD
		1	2	3	4	
Spring wheat						
Height	cm	63.9	58.9	57.6	56.6	3.0
Straw mass	g·running meter^{-1}	126.1	72.7	68.7	69.6	17.0
Spike number	spike·running meter^{-1}	110.5	79.7	73.2	73.4	12.2
Number of grains per spike	grain	35.94	29.93	30.31	28.98	2.32
Mass of 1000 grains	g	29.7	29.7	29.7	29.4	ns
Spring triticale						
Height	cm	75.1	73.9	71.5	71.3	2.1
Straw mass	g·running meter^{-1}	110.4	67.3	60.1	55.8	11.2
Spike number	spike·running meter^{-1}	79.8	55.0	52.4	51.2	6.7
Number of grains per spike	grain	39.7	34.1	30.5	29.7	1.83
Mass of 1000 grains	g	32.9	32.6	32.3	32.6	ns
Spring barley						
Height	cm	45.6	44.7	46.4	46.0	ns
Straw mass	g·running meter^{-1}	124.5	71.7	69.2	70.9	19.1
Spike number	spike·running meter^{-1}	139.0	102.7	99.2	99.2	15.8
Number of grains per spike	grain	24.8	21.3	21.2	21.1	2.21
Mass of 1000 grains	g	40.6	39.5	39.0	39.5	0.69
Oat						
Height	cm	89.2	81.8	81.2	81.3	5.4
Straw mass	g·running meter^{-1}	115.1	59.2	52.8	52.5	11.9
Panicle number	panicle·running meter^{-1}	61.2	42.5	42.4	44.2	9.3
Number of grains per panicle	grain	50.4	31.4	27.4	28.4	7.08
Mass of 1000 grains	g	30.3	30.0	30.1	30.0	ns

Border effect concerned also other cereal plant characteristics. Barley straw mass in the row adjacent to the path was higher by 75.6%, and oat nearly 2.2 times than in the fourth row (Table 4). Even though in the second row a tendency for higher straw mass was noted in the studied species, only in the case of triticale it was actually statistically significant. Spike or panicle number and the number of grains in the syncarps of all the cereal species in the border rows were significantly higher than in the subsequent rows. Relatively lowest increase in syncarp number in the first row was noted in oat – 38.5%, although the increase in grain number in the syncarps of that plant was the highest and amounted to 77.5%. On the other hand, border effect did not cause any increase in the mass of 1000 grains of cereals, with the exception of barley.

Results of the experiment indicate that the border effect determines the yield of plants affected by it (Table 5). This phenomenon reached the first and third rows of pea and triticale, and in the case of yellow lupine its significant effect occurred also in the third row. Seed mass of the remaining plant species only in the first row, directly adjacent to the unsown area, was higher than in the middle of the plot (the fourth row). Oat was the species that responded the most strongly and its grain mass in the row adjacent to the path was 2.4 times higher than inside the lowland meadow. Also earlier studies point out the diversification of border effect in particular plant species. Niemczyk and Buliński [2012] wrote that in the case of winter triticale, border effect concerns not only the first row, but also the neighbouring ones. Stawiana-Kosiorek et al. [2007] found that border effect in winter triticale cultivation may reach 40 cm into the lowland meadow. Pacewicz [2000] demonstrated the border effect in experiments with spring barley and spring wheat in one border plant row at the path width of 36 cm and border effect including two rows at the path width of 60 cm.

Table 5. Effect of plant row on the plot on seed/grain mass and border effect index (EB)

Species	Unit	Row from the path				LSD
		1	2	3	4	
Yellow lupine	g·running meter^{-1}	35.7	27.7	23.0	20.9	1.94
	EB	1.7	1.3	1.1	1.0	
Pea	g·running meter^{-1}	64.2	46.5	40.1	36.0	9.93
	EB	1.8	1.3	1.1	1.0	
Spring wheat	g·running meter^{-1}	101.4	62.7	58.4	55.3	8.03
	EB	1.8	1.1	1.1	1.0	
Spring triticale	g·running meter^{-1}	76.4	49.2	41.4	41.5	6.18
	EB	1.8	1.2	1.0	1.0	
Spring barley	g·running meter^{-1}	91.9	56.2	53.7	53.8	11.59
	EB	1.7	1.0	1.0	1.0	
Oat	g·running meter^{-1}	90.9	40.8	35.0	38.4	13.70
	EB	2.4	1.1	0.9	1.0	

In field production, border effect is a desirable phenomenon, since it compensates partly or entirely for yield losses that result from the use of part of the plot for tramlines [Niemczyk 2009]. However, in agricultural experiments this phenomenon carries the risk of a systematic error that results from the overestimation of the values of the particular plant characteristics. If the border effect has the same value for all the plots, the differences between the particular plots are proportional. When the border effect for some of the factors, for example sowing density, has different values [Rudnicki and Gałęzewski 2006], not only result overstatement occurs by a certain amount, but also the differences between the particular plots change. Depending on the plant species and size of the experimental unit, the harvest of the particular species from the entire area overestimated the yield in the present studies by 18.3%-28.0% (Table 6). The greater the plot area, the smaller the assessment error. Error scale depends on the value of the border effect index and the number of plant rows farther into the plot included in its effect. The greatest yield overestimation occurred in oat cultivation. It was demonstrated that the omission of one border row on both sides of the plot during harvest eliminated the border effect for barley and oat (yield overestimation lower than 1.0%), but was insufficient for the remaining species, particularly legumes. In those plants, the reach of border effect was greater than in cereals and only excluding two rows on both sides of the plot from harvest limited the effect of the described phenomenon on the yield to about 2.0%. In the case of oat, for which in the third row the yield was the lowest, caused probably by the strong competition of more vigorous plants from the edge of the plot, omitting two border rows during harvest understated slightly the estimated yield.

Table 6. Degree of yield overestimation (Z) on the experimental plots of different sizes depending on the number of plant rows adjacent to the path omitted during harvest

Omitted rows	Plot area m^2	Yield overestimation, %					
		yellow lupine	pea	spring wheat	spring triticale	spring barley	oat
All collected – no omitted	9	23.5	24.8	21.3	21.3	21.3	28.0
	12	22.3	23.5	20.3	20.2	20.2	26.6
	18	21.2	22.3	19.2	19.2	19.2	25.2
	24	20.6	21.7	18.7	18.6	18.6	24.5
	30	20.2	21.3	18.3	18.3	18.3	24.1
One omitted	9	8.8	8.5	4.0	3.8	0.8	-0.5
	12	8.4	8.0	3.8	3.6	0.8	-0.5
	18	8.0	7.6	3.6	3.4	0.7	-0.5
	24	7.7	7.4	3.5	3.3	0.7	-0.5
	30	7.6	7.3	3.4	3.3	0.7	-0.4
Two omitted	9	2.1	2.4	1.2	0.0	-0.1	-1.8
	12	2.0	2.3	1.1	0.0	-0.1	-1.8
	18	1.9	2.1	1.0	0.0	-0.1	-1.7
	24	1.8	2.1	1.0	0.0	-0.1	-1.6
	30	1.8	2.1	1.0	0.0	-0.1	-1.6

CONCLUSIONS

1. Border effect caused the increase of the values of nearly all the vegetative and generative characteristics of spring cereals and legumes, and usually oat was affected to the greatest extent.
2. Reach of the border effect in cereals in relation to the majority of the characteristics was limited only to the plant row directly adjacent to the path. In the case of legumes, the effect was visible also in the subsequent two rows into the lowland meadow.
3. Yield of the plants collected from the entire plot area, depending on the plot size and plant species, was higher by 18.3%-28.0% than in the mid part, calculated for an analogous area.
4. In order to avoid border effect influencing the estimation of yield size, during harvest one border row on both sides of the experimental plot ought to be omitted for oat, and two rows for spring triticale and barley. In the case of spring wheat, yellow lupine and pea, three plant rows from each side of the plot ought to be excluded from harvest.

REFERENCES

Michalska M., Wanic M., Jastrzębska M., 2008. Konkurencja pomiędzy jęczmieniem jarym a grochem siewnym w zróżnicowanych warunkach glebowych. Cz. II. Intensywność oddziaływań konkurencyjnych [The influence of competition between spring barley and field pea on content of macroelements in different parts of the plants]. Acta Sci. Pol., Agricultura 7(2), 87-99, www.agricultura.acta.utp.edu.pl [in Polish].

Niemczyk H., 2004. Znaczenie ścieżek przejazdowych w ograniczaniu niekorzystnego oddziaływania kół agregatów rolniczych na właściwości fizyczne gleby i plonowanie roślin [The effect of tramlines in limiting the unfavourable effect of wheels of running outfits on soil physical properties and plants yielding]. Ann. Univ. Mariae Curie-Skłodowska, Ser. E, Agricultura 59(2), 913-922 [in Polish].

Niemczyk H., 2009. Zdolność rzepaku ozimego do wyrównywania plonu z nieobsianej powierzchni ścieżek technologicznych [The ability of winter oilseed rape to compensate for the loss of yield from the unsown area of tramlines]. Fragm. Agron. 26(3), 128-136 [in Polish].

Niemczyk H., 2011. Plonowanie ziemniaka w uprawie ze ścieżkami przejazdowymi [Potato yields in field with tramlines]. Fragm. Agron. 28(3), 82-90 [in Polish].

Niemczyk H., Buliński J., 2012. Wpływ ścieżek przejazdowych na plon roślin uprawnych [Tramline effect on yield of crops]. Inż. Rol. 2(136), t. 1, 277-286 [in Polish].

Pacewicz K., 2000. Efekt brzeżny w doświadczeniach z pszenicą jarą i jęczmieniem jarym [Border effect in experiments with spring wheat and spring barley]. Rozpr. doktorska, AR Szczecin [in Polish].

Rudnicki F., Gałęzewski L., 2006. Efekty oddziaływań brzegowych w doświadczeniach z owsem wysiewanym w różnych gęstościach [Border effect in experimental study with sowing rate of oat]. Biul. IHAR 239, 73-83 [in Polish].

Rudnicki F., Gałęzewski L., 2008a. Efekty brzegowe w doświadczeniach z mieszankami owsa i łubinu żółtego. I. Zasięg efektu brzegowego [Border effects in trials with oat and yellow lupine mixture Part I. Range of border effect]. Acta Sci. Pol. Agricultura (4), 81-86, www.agricultura.acta.utp.edu.pl [in Polish].

Rudnicki F., Gałęzewski L., 2008b. Efekty brzegowe w doświadczeniach z mieszankami owsa i łubinu żółtego. II. Reakcje owsa i łubinu w mieszankach i siewach czystych na sąsiedztwo ścieżek w doświadczeniu [Border effects in trials with oat and yellow lupine mixtures Part II. Response of oat and lupine plants grown in mixtures and pure sowing to nearness of experimental paths]. Acta Sci. Pol. Agricultura (4), 87-94, www.agricultura.acta.utp.edu.pl [in Polish].

Rudnicki F., Gałęzewski L., 2008c. Efekty brzegowe w doświadczeniach z mieszankami owsa i łubinu żółtego. III. Wpływ efektu brzegowego na dokładność oceny plonu w doświadczeniach [Border effects in trials with oat and yellow lupine mixtures Part III. Influence of border effect in field trials on accuracy of yield estimation]. Acta Sci. Pol. Agricultura (4), 95-103, www.agricultura.acta.utp.edu.pl [in Polish].

Sobkowicz P., 2003. Konkurencja międzygatunkowa w jarych mieszankach zbożowych [Interspecies competition in spring cereal mixtures]. Zesz. Nauk. AR Wrocław, Rozprawy 194 [in Polish].

Stawiana-Kosiorek A., Gołaszewski J., Załuski D., 2003. Konkurencyjność roślin w doświadczeniach hodowlanych z grochem siewnym. I. Oddziaływania brzegowe [Plant competition in plant breeding trials with pea (*Pisum sativum* L.) Part I. Border interference] Biul. IHAR 226/227(2), 425-439 [in Polish].

Stawiana-Kosiorek A., Gołaszewski J., Załuski D., 2007. Efekty konkurencyjności roślin pszenżyta ozimego w doświadczeniach polowych [Competition effects of winter triticale plants in field trials]. Biul. IHAR 243, 97-107 [in Polish].

EFEKTY BRZEGOWE W UPRAWIE WYBRANYCH GATUNKÓW ROŚLIN UPRAWNYCH

Streszczenie. Większa dorodność roślin graniczących z nieobsianą przestrzenią, określana jako efekt brzegowy, rekompensuje użytkowanie ścieżek technologicznych w łanie, ale również obarcza błędem wyniki badań polowych. Zjawisko to jest dobrze poznane dla poszczególnych gatunków roślin uprawnych, brak jest jednak opracowań umożliwiających analizę i porównanie efektu brzegowego kilku gatunków roślin w podobnych warunkach siedliskowych, ocenianego w ten sam sposób. Celem badań było poznanie i porównanie efektu oddziaływań brzegowych w uprawie zbóż jarych: pszenicy, pszenżyta, jęczmienia i owsa oraz grochu siewnego i łubinu żółtego, a także określenie wpływu tego zjawiska na przeszacowanie plonu w doświadczeniu poletkowym. W latach 2004-2010 w Stacji Badawczej Wydziału Rolnictwa i Biotechnologii UTP w Mochełku (53°13' N; 17°51' E) przeprowadzono serię doświadczeń poletkowych, każde według takiej samej metodyki. Czynnikiem doświadczalnym było położenie rzędu roślin na poletku, oceniano 4 rzędy w głąb poletka od nieobsianej ścieżki o szerokości 50 cm. Stwierdzono, że efekt brzegowy skutkował większą wartością niemal wszystkich określanych cech roślin, najbardziej podatny na jego wpływ okazał się owies. Efekt brzegowy u zbóż w odniesieniu do większości cech ograniczał się tylko do rzędu roślin przyległego bezpośrednio do ścieżki, w kolejnych dwóch rzędach wartości poszczególnych cech były zazwyczaj zbliżone do oceny dokonanej w rzędzie czwartym. W przypadku roślin strączkowych efekt ten uwidoczniał się również w kolejnych dwóch rzędach w głąb łanu. Plony roślin zbieranych z całej powierzchni poletek, w zależności od ich powierzchni i gatunku rośliny, były większe o 18,3-28,0% niż w środkowej ich części. Stwierdzono również, iż w celu uniknięcia wpływu efektu brzegowego na oszacowanie wielkości plonu zaleca się pominięcie przy zbiorze z obu stron poletek doświadczalnych po jednym skrajnym rzędzie roślin owsa, po dwa rzędy pszenżyta i jęczmienia. W przypadku pszenicy, łubinu i grochu należałoby wyłączyć ze zbioru po trzy rzędy roślin z każdej strony poletka.

Słowa kluczowe: błąd doświadczalny, rośliny strączkowe, rzędy brzeżne, zboża jare

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