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Effect of the depth and rate of sowing on the yield and yield components of determinate and indeterminate faba beans (*Vicia faba* var. *minor* L.) cultivars under conditions of Southwestern Poland

Wpływ głębokości i gęstości siewu na plon i jego komponenty w uprawie samokończącej i niesamokończącej odmiany bobiku (*Vicia faba* var. *minor* L.) w warunkach Polski południowo-zachodniej

Summary. Sowing depth and sowing density are considered important factors that affect the yield and profitability of crop cultivation. This study aimed to evaluate the effect of differentiated sowing depths and rates on the yield components and seed yield of two faba bean morphotypes: Bobas – indeterminate growth habit and Granit – determinate growth habit, grown in Southwestern Poland in the years 2011–2013. The course of weather in the years of research had the strongest impact on the studied yield components and yield. The indeterminate Bobas cultivar was characterized by the most beneficial morphological traits, compared to the determinate Granit cultivar. Among the tested sowing rates, 60 and 75 seeds per 1 m^2 caused the highest yield. The depth of sowing had only a significant effect on seed yield; the highest yield was found at 5 cm compared to deeper sowing.

Key words: sowing depth, sowing rate, faba bean, yield, determinate and indeterminate cultivar

INTRODUCTION

Faba bean is a cool season legume crop that offers several benefits to the agroecosystem, especially when grown through crop rotation and intercropped with cereals, that is, wheat and barley [Köpke and Nemecek 2010]. In 2019, the average global yield of dry faba bean seeds was 1.80 t ha^{-1}. Globally, faba beans are produced mainly in China, Europe, Northern Africa, West Asia, and Australia [Rawal and Navarro 2019]. In 2019, in the European Union, the average yield was 2.90 t ha^{-1} in Poland reached 2.30 t ha^{-1} of dry faba beans [FAO 2021]. The study of grain legume production in years 2014–2018 in the EU shows that faba bean production with ~1 800 000 t is the third most produced grain legume in the EU after soybeans (~2 500 000 t) and dry pea (2 100 000 t). Faba bean is used mainly as feed in the EU. Exports outside the EU are mainly concerned on two markets: Egypt, as a food and Norway as a fish feed. Poland is the eight-producing faba bean in the EU [Kezeya Sepngang et al. 2020].

The depth of sowing is a very important agronomic factor that has direct and indirect effects on the growth and development of plants by absorbing water and germination of seeds. Optimal seed depth is considered a desirable goal in all crop establishment systems [Karayel and Özmerzi 2008]. The appropriate depth of sowing depends on the type, mechanical composition of the soil, and the weather conditions of the region where production is leading [Baye et al. 2020]. The depth of sowing is crucial to achieve an effective and higher crop yield through the potential for seedling emergence. Inappropriate sowing depth can reduce yield by 15–20% or even more, as this parameter leads to better germination, increased yield and decreased competition between plants.

The choice of the sowing rate is an important agronomic practice that influences the yield components, and yield, and generally the profitability of a crop in the farming system. Pulses seeds are expensive, in comparison to other crops. With the recommended high seeding rates, the seed cost can make cultivation unprofitable. There are variances in the available literature in the determination of the optimal sowing rate for faba beans [López-Bellido et al. 2005, Gezahegn et al. 2016, Wakweya et al. 2016]. The range of faba bean sowing rates varies from country to country and its weather conditions: United Kingdom (45 to 65 plants per 1 m^2), Southern Australia (30 plants per 1 m^2), Germany (19 to 74 plants per 1 m^2) [López-Bellido et al. 2005].

In our work hypothesis, we assumed that low input factors in cultivation technology, such as the depth and rate of sowing, would significantly affect the yield and yield components of two morphotypes of faba beans (determinate and indeterminate).

MATERIALS AND METHODS

In the years 2011–2013, a field experiment was performed on the experimental field of the Wrocław University of Environmental and Life Sciences in Poland (51°10'N, 17°06'E) to investigate the effect of sowing depth and rate on yield and its components for two faba bean cultivars.

The field experiment was performed in a split-split-split-plot design. Years of experiment were the superior factor. Two sowing depths (5 cm and 8 cm) were allocated in the main plots, two faba bean cultivars (Bobas, characterized by indeterminate growth, and Granit, characterized by determinate growth) were placed in the sub-plots, and three sowing rates (45, 60, 75 pcs m^{-2}) were placed in the sub-sub-plots. Four randomized replications were carried out in the experiment. The size of the single sub-sub-plot was 15.0 m^2 (10 m × 1.5 m). The experimental field was cultivated according to standard faba bean crop management techniques and standard agronomic practices. Winter wheat (*Triticum aestivum* L.) was the preceding crop in each year of the experiment.

The faba bean cultivars were sown on 31 March 2011, 26 March 2012, and 16 April 2013, when due to frosty March, the sowing date had to be delayed. Immediately before sowing, the seeds were inoculated with an inoculant dedicated to faba bean. A drill with hydraulic coulter pressure was used to maintain the appropriate seeding depth of 8 cm and 5 cm. The harvest was carried out at full maturity of the seeds in the second week of August, in each study year. The fertilization was as follow (in kg ha^{-1}): N – 30, P_2O_5 – 60, K_2O – 100. Plant protection was carried out according to the assumptions of integrated pest management. Weather conditions in the years of research are presented in Table 1. Temperature in growing season of faba bean in the years of research exceeded the long-term average 1986–2015. The average highest temperature was noticed in 2011 and 2012. The highest temperature in growing season was found in July and August even higher compared to the long-term average 1986–2015. Average sum of precipitation in years of experiment was much higher compared to the long-term average 1986–2015. The most abundant year in terms of precipitation was 2013 while the lowest in rainfall 2012.

The experiment was conducted on typical brown luvisol developed from light loam underlain by medium loam, in Poland evaluated as class IIIb (3rd class of 9) and of 2nd complex of agricultural usefulness (2nd complex of 14), suitable for wheat production [FAO 2014]. Abundance in elements and pH in the soil are presented in Table 2.

The following traits were measured on 10 randomly selected plants sampled at the end of growing season from each sub-subplot before harvest: number of pods per plant (PP, pcs), number of seeds per plant (SP, pcs), and seed weight per pod (SWPD, g).

Table 1. Weather conditions in the years of field experiment

Month	Temperature (°C)				Precipitation (mm)			
	2011	2012	2013	average 1986–2015	2011	2012	2013	average sum 1986–2015
March	4.4	6.1	–0.9	3.8	45.2	13.7	43.0	38.2
April	11.9	9.8	9.2	8.9	27.0	27.6	42.7	33.6
May	14.8	15.8	14.6	14.4	49.4	63.7	136.0	54.1
June	19.1	17.3	17.7	17.3	95.7	94.7	171.7	67.4
July	18.2	20.0	20.5	19.6	170.9	108.0	36.3	78.9
August	19.3	19.3	19.0	18.6	78.9	73.2	68.2	65.3
Average temp. and total precipitation of vegetation period	14.6	14.8	13.4	13.8	467.1	380.9	497.9	337.5

Table 2. Soil properties in years of field experiment

Years	pH in 1 M KCl		Macronutrient concentration (mg kg^{-1})					
			P		K		Mg	
2011	5.8	slightly acidic	74	high	179	high	72	high
2012	6.2	slightly acidic	73	high	133	medium	96	very high
2013	5.9	slightly acidic	62	medium	116	medium	87	high

After harvest, 1000 seed weights (TSW, g) from each sub-subplot according to the International Rules for Seed Testing [ISTA 2013] and seed yields (SY, t ha^{-1}) were determined. Seed yields from sub-sub-plots into seed yields per hectare were converted with 12% moisture of seeds.

According to Lindeberg-Lévy's theorem (central limit theorem CLT), the distribution of variables such as yield and its components converges asymptotically to the normal distribution.

Data from independent biometric features were subjected to Anova statistical analysis in Statistica software (version 13.1 StatSoft, Poland). The level of significance was $\alpha = 0.05$. The above experiment was based on four factors: the years of research were the statistically superior factor, and then: two sowing depths, two cultivars, and three sowing rates in four repetitions. Tukey's multiple range test was performed to determine homogenous groups. In the conducted Tukey test, the means denoted by different letters are significantly different at $p < 0.05$. The letters 'a' to 'f' express the value of the traits analysed, where 'a' denotes the most favourable value.

RESULTS

Significant differences were identified between traits tested in three-year of research. Sowing depth influenced significantly only on SY. The effect of the examined cultivars had a significant impact on the investigated parameters (Tab. 3). The sowing rate significantly modified PP, SP, and SY.

Table 3. ANOVA for the effect of year, sowing depth, cultivar, and sowing rate on the investigated traits

Specification		PP	SP	SWPD	TSW	SY
p-value						
Factors	year (Y)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	sowing depth (SD)	0.5788	0.4476	0.3902	0.2346	0.0284
	cultivar (C)	0.0895	<0.0001	<0.0001	<0.0001	<0.0001
	sowing rate (SR)	<0.0001	<0.0001	0.2136	0.6625	<0.0001
Interactions	Y × SD	0.6959	0.7124	0.0045	0.0009	0.0003
	Y × C	0.0685	0.0056	0.0715	0.1337	<0.0001
	SD × C	0.4606	0.5973	0.1359	0.8974	0.4482
	Y × SR	0.2673	0.3167	0.0740	0.9977	0.5190
	SD × SR	0.6889	0.8564	0.7041	0.4638	0.8297
	C × SR	0.4446	0.1150	0.2656	0.0823	0.5400
	Y × SD × C	0.8388	0.5992	0.1293	0.1668	0.2194
	Y × SD × SR	0.8957	0.9744	0.3079	0.5063	0.2778
	Y × C × SR	0.2262	0.4328	0.6532	0.4607	0.6440
	SD × C × SR	0.6237	0.6417	0.4588	0.7617	0.6325
	Y × D × C × SR	0.5832	0.8477	0.1901	0.7460	0.6178

PP – number of pods per plant (pcs.), SP – number of seeds per plant (pcs.), SWPD – seed weight per pod (g), TSW – thousand seed weight (g), SY – seed yield (t ha^{-1}).

The interaction of Y × C significantly affected the following traits: SP, TSW, and SY. The interactions of Y × SR, C × SR, and Y × C × SR were not observed. Taking into account interaction: sowing depth with other factors (Y × SR, Y × SD × SR, Y × C × SR, SD × C × SR, Y × SD × C × SR) were not statistically significant for all measured traits.

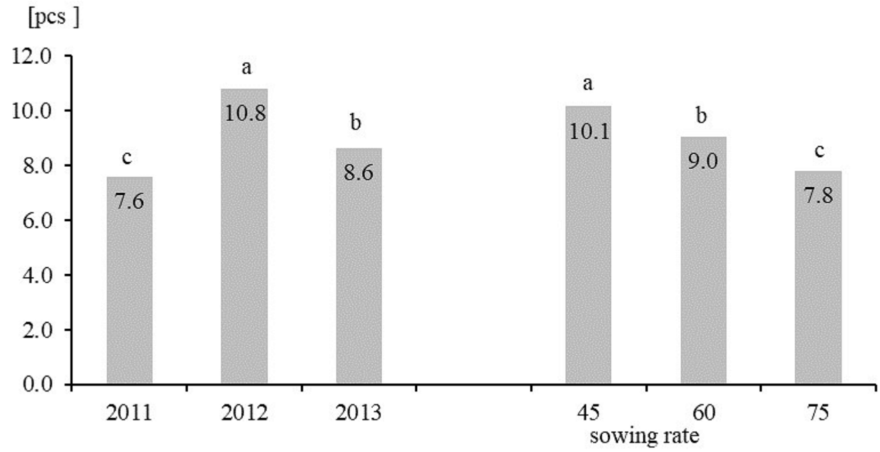

Fig. 1. Effect of the year and sowing rate on the number of pods per plant (pcs.)

The number of pods per plant was significantly modified by conditions in years of research and by sowing rate. The highest value of this trait was stated in 2012 (10.8 pcs.), while in 2011 the lowest (7.6 pcs.). Increasing the number of seeds seeded per 1 m^2 caused a decrease in the number of pods produced by 1 plant (Fig. 1).

The number of seeds per plant was shaped by factors such as the year of research, the cultivar, and the sowing rate (Tab. 3 and Fig. 2). The highest number of seeds per plant was stated in 2012 (28.4 pcs.). The Bobas cultivar produced around 15% signifi-cantly more seeds per plant than Granit. A decreasing line was observed in the number of seeds per plant when the sowing rate increased.

The interaction of year and cultivar (Y × C) also significantly affected the number of seeds per plant. The highest value of the trait analysed was found in the 2012 in the Bobas cultivar (31.5 pcs.) (at about 85%) compared to Granit in 2011 (Fig. 3). In each year of research, the interaction showed Bobas as a higher-yielding cultivar in conditions of Lower Silesia region in Poland.

The weight of seeds per pod varied significantly in years of research and was the highest in 2011 – 1.6 g, while the lowest in 2013 – 1.1 g (45% lower compared to 2011). The trait analysed was also modified by cultivar. Bobas was characterized by a higher seed weight per pod than Granit: 1.5 g and 1.1 g, respectively (Fig. 4).

This parameter was also affected by the interaction between the year and the sowing depth (Fig. 5). The highest seed weight per pod was found in 2011 (1.6 g) in both sowing depths and was at about 60% higher compared to the lowest in 2013 by deeper sowing (8 cm).

In 2011, a significantly higher 1000 seed weight was stated – 651 g, while the lowest was stated in 2013 – 432 g. The highest value in 2011 was greater at around 51% compared

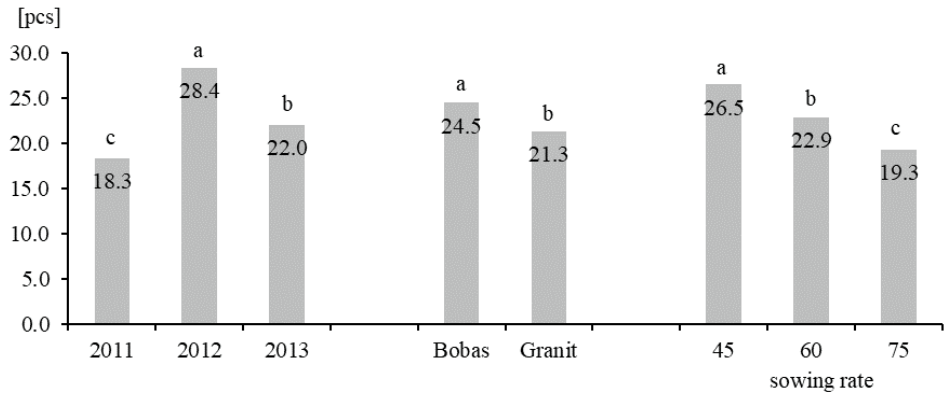

Fig. 2. Effect of year, cultivar and sowing rate on the number of seeds per plant (pcs.)

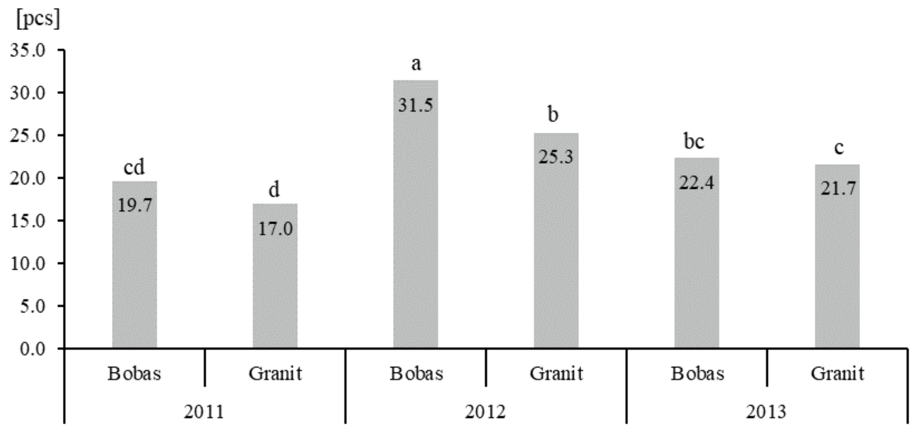

Fig. 3. Effect of interaction between year and cultivar on the number of seeds per plant (pcs.)

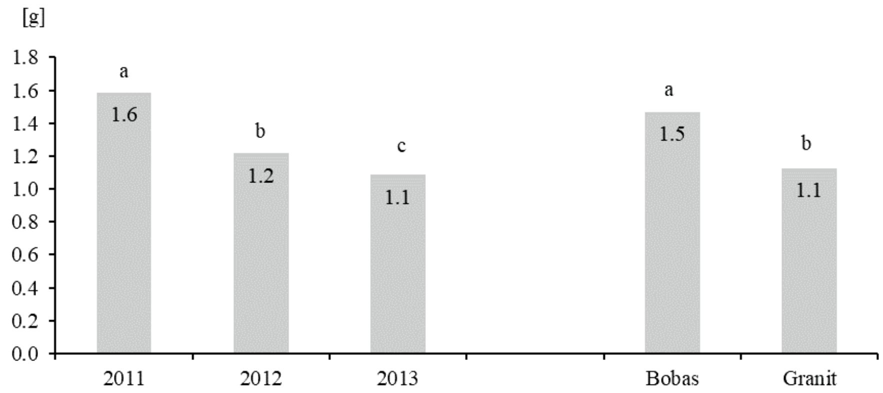

Fig. 4. Effect of year and cultivar on seed weight per pod (g)

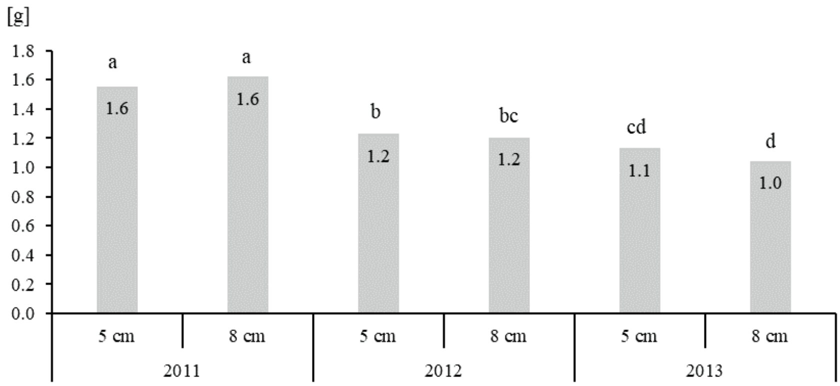

Fig. 5. Effect of interaction between year and sowing depth on seed weight per pod (g)

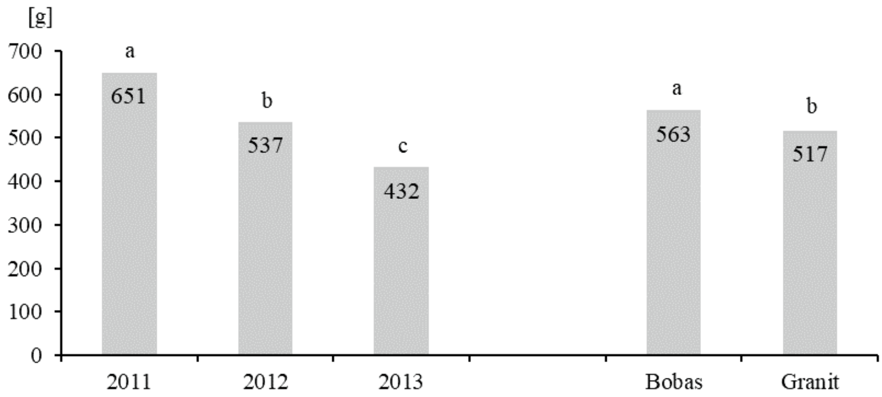

Fig. 6. Effect of year and cultivar on thousand seed weight (g)

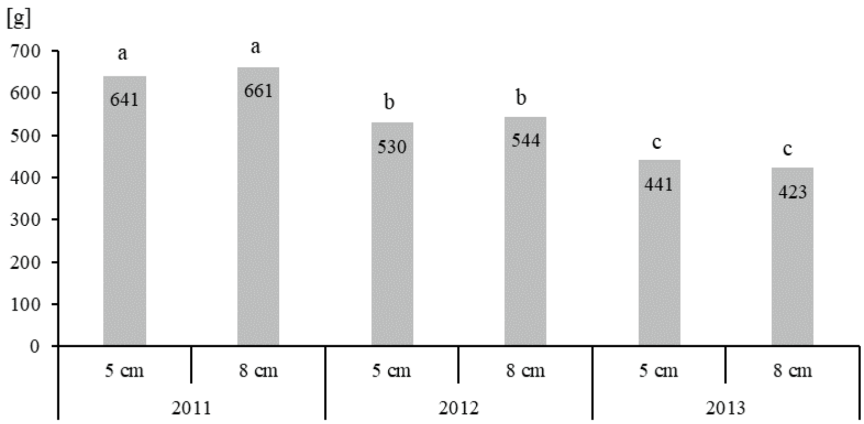

Fig. 7. Effect of interaction between year and sowing depth on thousand seed weight (g)

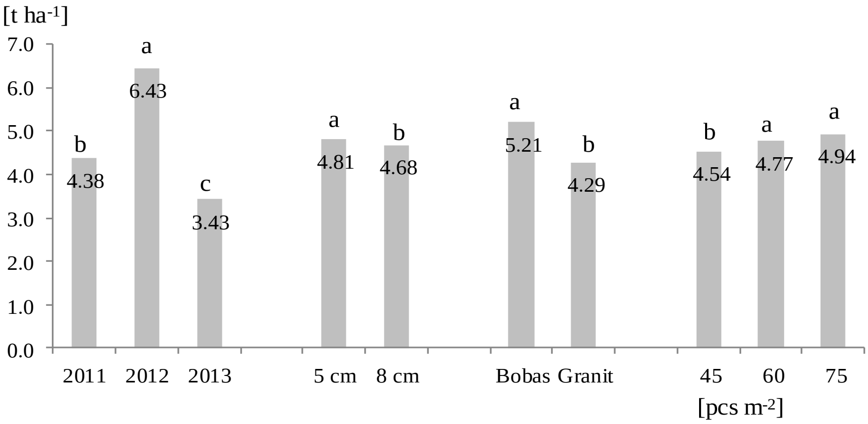

Fig. 8. Effect of year, sowing depth, cultivar, and sowing rate on seed yield (t ha^{-1})

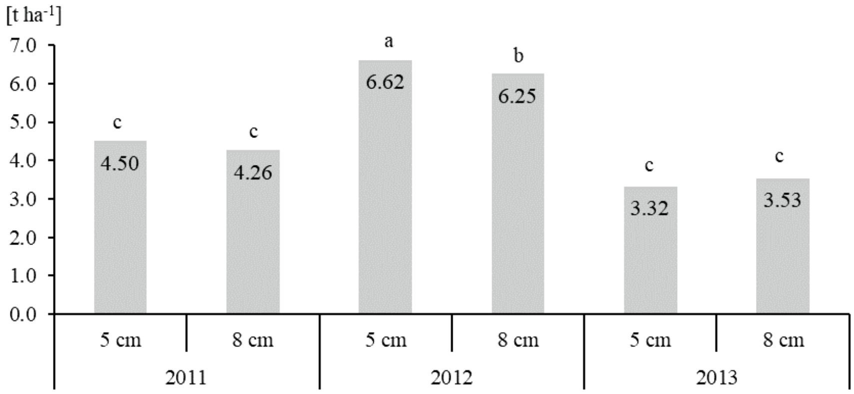

Fig. 9. Effect of the interaction between year and sowing depth on seed yield (t ha^{-1})

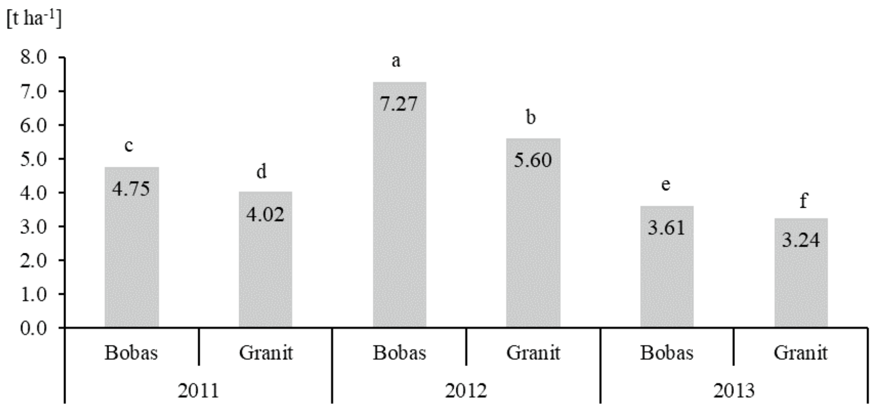

Fig. 10 Effect of the interaction year and cultivar on seed yield (t ha^{-1})

to the lowest value in 2013. Bobas achieved a greater value at about 9% higher compared to Granit (Fig. 6).

The significant impact of the interaction between the conditions in the year of research and the depth of the sowing was stated. In 2011, the thousand seed weights were the highest, while in 2013 the lowest, regardless of the depth of sowing (Fig. 7).

The seed yield was strongly affected by all the factors examined. The highest seed yield was obtained in 2012 and amounted 6.43 t ha^{-1}. The shallower depth of sowing, at 5 cm, led to a significant increase (at about 2%) in seed yield, compared to the deeper sowing (8 cm). Bobas produced significantly higher yield (more than 21% higher) than Granit: 5.21 and 4.29 t ha^{-1}, respectively. Among the sowing rates tested, 60 and 75 seeds sown per 1 m^2 contributed to a higher seed yield at about 5–9% – than using 45 seeds (Fig. 8).

Analysing the Y × SD interaction, the highest seed yield was declared in 2012 when the seeds were sown shallow (5 cm). In this case seed yield amounted 6.62 t ha^{-1} (Fig. 9).

In case of Y × C interaction, the highest yield was obtained in 2012 from the Bobas cultivar – 7.27 t ha^{-1}, while the lowest seed yield was obtained in 2013 from the Granit – 3.24 t ha^{-1} (Fig. 10). Differences between yield exceeded 100%.

DISCUSSION

Weather conditions, along with soil and agrotechnical treatments, are of great importance for the growth, development, and yielding of pulses. The most essential climate yield-forming conditions are air temperature and precipitation, especially in critical period, i.e., during flowering and pod setting [Fordoński 1993]. Optimal water requirements for faba bean amounts 300–500 mm [Kulig et al. 2011]. In our research, the course of the weather conditions played an essential role in shaping all the features examined (Tab. 3). In our study, precipitation during the vegetation period was favorable for the cultivation of faba beans and reached 380.9–497.7 mm (Tab. 1). However, low rainfall in July 2013 when the pods were setting could lead to a decrease in seed weight per pod, thousand seed weight, and seed yield (Fig. 4, 6, 8). 2012 was characterized by the highest air temperature during vegetation (14.8°C) and, in the meantime, the lowest rainfall (380.9 mm) – Table 1, which could contribute to the increase in the number of pods and seeds per plant, as well as the seed yield (Fig. 1, 2, 8).

Among the factors tested in our study, the genotype had an important effect on all traits examined, except the number of pods per plant (Tab. 3). In our study, the Bobas (indeterminate) cultivar formed significantly more seeds per plant compared to the Granit (determinate) cultivar, with a higher weight of seeds per pod and the weight of 1000 seeds, and first of all, the seed yield (Fig. 2, 4, 6, 8). Increase of seeds per plant for Bobas was 15% higher compared to Granit, seed weight 36%, mass of 1000 – 9% and seeds yield was higher for Bobas at around 21%. Study by Podleśny [2009] faba bean plants of the Nadwiślański (indeterminate) cultivar produced more pods than the Tim (determinate) cultivar, but Tim was characterized by a higher number of seeds per pod and 1000 seed weight, which is contradictory to our research. Podleśny and Podleśna [2003] showed that determined varieties of some legumes yielded less well and are more sensitive to water deficit and to high temperatures during flowering than indeterminate cultivars. At the same time, they produce a lower biomass yield, which may be related to a lower demand for water during growth [Podleśny and Podleśna 2010] associated with lower transpiration.

In our study, the indeterminate cultivar yielded better compared to the determinate Granit (Fig. 10). In 2011 Bobas yielded at about 18% higher compared to Granit, in 2012 – 30% and in 2013 – 11% (Fig. 10). Our results indicate the presence of variability among faba bean cultivars considering yield components, which are similar to those obtained for previous faba bean genotypes by other researchers [Karadavut et al. 2010]. This variability may be due to genetic factors or both genetic and environmental factors [López-Bellido et al. 2005]. According to Dobocha et al. [2019], the varieties had no significant effect on the thousand seed weight (TSW) as well as in our study. Furthermore, Podleśny [2009] pointed out that cultivars differed in their resistance/sensitivity to weather conditions contradictory to our study where Bobas cultivar turned out to be more adapted to conditions of Lower Silesia, Southwestern Poland.

In our study, we tested strictly agrotechnical factors such as the depth and rate of sowing to make recommendations for the cultivation of faba beans. However, differentiated weather conditions have an overriding influence on the yield of faba beans. Sowing rate had an impact on majority of analysed traits, but sowing depth had significant impact only on seed yield (Tab. 3).

Sowing density is an important element in the production of seed yield and the economic benefits of faba bean cultivation. The sowing rate can maximize yield and stabilize production [Pilbeam et al. 1991] and is believed to have an important effect on many morphological traits, such as the number of pods per plant, the yield, and the weight of 1000 seeds [López-Bellido et al. 2005]. The seeding rate had a significant impact on the number of pods per plant, the number of seeds per plant, and the seed yield in our study (Tab. 3). Abdallah [2014] found that increasing the sowing density (from 25 to 33 plants per 1 m^2) significantly reduced the number of pods per plant, as well as in our study (Fig. 1). In our study, the highest number of pods per plant was observed using 45 seeds on 1 m^2 and the lowest number of pods using 60 and 75 seeds on 1 m^2 (Fig. 1). According to Khalil et al. [2011], the highest number of pods per plant was observed in the lowest plant population, what is in agreement with our study. In the study by Wakweya et al. [2016], the sowing rate had a nonsignificant impact on the seed yield of faba bean**.** The result found in this study is consistent with Al Tawaha and Turk [2002] who found statistically non-significant effect of seeding rate on lentil grain yield. The same results as Wakweya et al. [2016] and Al Tawaha and Turk [2002] were obtained by Turk and Al Tawaha [2002], who also noticed the non-significant impact of the seeding rate on the seed yield of lentils. In our study, the increase in the sowing rate from 45 to 60 and 75 seeds per 1 m^2 contributed to the increase in seed yield (Fig. 8). According to López-Bellido et al. [2005], plant density had a significant impact on seed yield: the higher plant density, the yield increased linearly. Schutte and Nleya [2019] and Dobocha et al. [2019] also stated that the seeding rate significantly affected seed yield. The application of the highest seeding rate resulted in a significant increase in seed yield, compared to lower seeding rate.

According to Baye et al. [2020], depth of sowing has a significant impact on the growth, yield, and germination of faba bean. In their study, the shallower depth of sowing caused better above-mentioned traits, minimizing competition between plants for available light, water, and nutrients compared to the deeper depth of sowing. According to Siddique and Loss [1999], deep sowing did not cause the decrease of seed yields, and in some cases, it was even greater. In turn, Singh et al. [2013] stated that the depth of the sowing had an impact on the number of pods per plant, the number of seeds per pod, the seed yield per plant, the weight of 1000 seeds, and the seed yield. Based on the results of the research conducted by these authors [Singh et al. 2013], the number of pods per plant and 1000 seed weight were higher at shallower depth of sowing (5 cm) compared to deeper depth of sowing (10 cm), and these values decreased with increasing depth of sowing. In our study, shallower depth of sowing caused higher yielding of faba bean, compared to deeper sowing (Fig. 8). Generally, the depth of pulses sowing should be varied to take into account crop species, soil type, and pest management. An important factor is how long the crop will take to emerge due to the temperature of the soil at the time of sowing. Deeper sowing in sandier soils is often recommended if applying a pre-emergent herbicide. The deeper sowing is suggested in soil with higher temperatures and if dry-sowing. The shallowest sowings are advised in heavy soils with low temperatures or late sowing [GRDC 2017].

In the identified significant interactions, conditions in the years of study were always observed as their component.

Interaction Y × SD significantly modified the seed weight per pod, the weight of 1000 seeds, and the seed yield (Tab. 3). According to the study by Wakweya et al. [2016], the average of the data over the three years showed that the density of sowing did not have a significant effect on the number of seeds per pod, which is consistent with Al Rifaee et al. [2004], however, our results did not prove this statement (Tab. 3). The results of our research are contradictory to the results conducted by Wakweya et al. [2016], Dobocha et al. [2019], Gezahegn et al. [2016], who found that the seed rate had shown a non significant effect on the thousand seed weight. The same results were obtained by Al Rifaee et al. [2004], where the density of the plant did not have an effect on the weight of thousands of seeds. According to Chen and Wiatrak [2010] an increase in the sowing rate allowed to improve the growth of soybeans, especially in the early vegetative stages, which can later be observed in higher seed yield and what can be proved by the results of our experiment.

The interaction of Y × C is observed in the number of seeds per plant and seed yield in our study (Tab. 3). According to Li and Yang [2014] and López-Bellido et al. [2005] genotype and environmental factors affect the seed yield of faba beans as well as in our study. Cultivar factor even showed a higher impact on seed yield than sowing rate [López-Bellido et al. 2005]. According to Pszczółkowska et al. [2020], the seed yield of faba bean indeterminate and determinate cultivars was differentiated in years of research and in the region of cultivation. Granit, the determinate cultivar was characterized by a higher seed yield compared to the indeterminate cultivar in all years of the experiment conducted. Our research showed that the Bobas indeterminate cultivar yielded significantly higher than the determinate Granit (Fig. 10). In our study Bobas (indeterminate cultivar) yielded in the range of 3.61 to 7.27 t ha^{-1}, while Granit determinate cultivar yielded from 3.24 to 5.60 t ha^{-1} (Fig. 10). Constant cultivar traits can be modified by unfavorable habitat or weather [Olle 2018].

The interaction of Y × SD had a significant impact on seed weight per pod, 1000 seed weight and seed yield (Tab. 3). In our experiment, the impact of weather conditions in years of research exceeded the impact of sowing depth on the traits mentioned above (Fig. 5, 7, 9). The strongest effect of the depth of sowing on this interaction was shown in the case of seed yield in 2012, where the higher yield was obtained at shallower depth (9% higher) – Figure 9. It is noteworthy that year 2012 was the warmest and the stiffest year of precipitation of the three years analysed (Tab. 1). Similar results indicated on stronger effect of climatic conditions than tested sowing depths were pointed by Johnston and Stevenson [2001]. However, they stated, that in pea cultivation, deeper sowing caused a reduction in seed yield, as well as in our study.

Interaction of sowing depth × cultivar and sowing rate × cultivar did not show any significant differences in examined traits (Tab. 3), what is unexpected, because available literature shows interactions between determinate and indeterminate cultivars and sowing rates in the case of yield components and yield. Hebblethwaite et al. [1983] stated that indeterminate cultivars require higher sowing density to obtain higher yield. Furthermore, Stützel and Aufhammer [1992] observed that at the same plant density, seed yield is lower in determinate cultivars than in indeterminate cultivars. Our observations of no significant interaction between genotype and sowing rate are consistent with the studies by Pilbeam et al. [1991]. Due to the discrepancies shown above, more research is needed to determine the optimal and economically beneficial sowing rate of faba bean morphotypes under weather conditions in the region of cultivation.

This discussion confirms that pulses yield is often strongly affected by environmental factors, even more than by cultivation, and that agricultural practice should be strictly related to the region of cultivation and its weather conditions.

CONCLUSIONS

The depth of sowing only influenced the seed yield, and shallower depth of sowing (5 cm) was more beneficial. The Bobas indeterminate cultivar showed more beneficial values of the yield components and seed yield compared to the determinate cultivar Granit. Higher sowing rates (60 and 75 seeds per 1 m^2) led to the significantly increase of seed yield in compare to 45 seeds per 1 m^2. In our opinion, due to the costs of seed material, using 60 seeds per 1 m^2 is more economically beneficial than 75 seeds per 1 m^2. In conclusion, the recommended sowing rate for faba beans in the conditions of Southwestern Poland is 60 seeds per 1 m^2, independent of the characteristics of the cultivar (determinate and indeterminate growth habit). It is noteworthy that pulses are sensitive to changing climatic conditions and that it is often dominant factor that affects their yielding.

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