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FLOWERING AND CHARACTERISTICS OF USEFUL TRAITS OF SOME FABA BEAN (*Vicia faba* L. var. *major* Harz) CULTIVARS AND BREEDING LINES

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Abstract

This study, conducted during the period 2008–2009, related to the growth, flowering, pod set, and yield of faba bean (*Vicia faba* L. var. *major*) cultivars and breeding lines. Biometric measurements, made on 20 randomly selected plants, included the following traits: plant height, number of branches per plant, number of inflorescences per plant and number of flowers per inflorescence, number of pods per plant: large pods (marketable), small pods (undeveloped), and pods with disease symptoms. Moreover, the following characters were determined: pod and seed weight per plant in faba bean plants harvested once at processing maturity of fresh green seeds, pod length, width and weight as well as single seed weight. The evaluated cultivars and breeding lines of faba bean were characterized by large variations in the most important commercial traits. The abundance and duration of flowering as well as the number and weight of pods per plant were clearly modified by weather factors during the growth of plants. The new breeding lines R-366/1 and R-384 as well as the cultivars 'Bachus' and 'Jankiel Biały' were characterized by quite stable pod and seed yield per plant. Single harvesting of faba bean pods for green seeds at green maturity stage produced positive results in the case of all cultivars and breeding lines investigated; marketable pods per plant accounted for 75–80% of the total number of pods.

Key words: *Vicia faba* L., cultivars, pods, seeds, green maturity stage

INTRODUCTION

Vicia faba L. is one of the more important species of the family Fabaceae grown throughout the world. Dry seeds of all botanical varieties of this species are the main source of protein and an essential component in human nutrition used daily in different regions of the world, among others, in China, Turkey, Egypt, Ethiopia, and Central America. The introduction of *Vicia faba* L. into cultivation has three main objectives: enrichment of human food and animal feed with protein, symbiotic nitrogen fixation in an agrosystem, and beneficial effects of crop rotation (Duc, 1997; Adak et al. 1999; Behre, 1999; Crepon et al. 2010; Jensen et al. 2010).

The large-seeded species *Vicia faba* L. var. *major* is most frequently grown in the southern regions of Europe and it is used in human nutrition as fresh green seeds or dry seeds. Apart from green seed yield, large quantities of aerial plant parts, which beneficially affect soil properties, are additionally obtained (Kmiecik and Lisiewska, 1989; Łabuda and Łabuda, 1990).

Faba bean seeds, with a high nutritional value at green maturity stage, are used for direct consumption and in food processing for freezing and canning. Therefore, the availability of cultivars with varying commercial traits, including traits such as earliness, plant productivity, suitability for single harvesting, seed colour and size, are also important and essential for faba bean green seed production, since this allows for different applications of green seeds, and this topic has been dealt with in the papers of many authors (Łabuda, 1991; Witek and Witek, 1994; Wierzbicka et al. 1995; Bartłomiejczak and Matczak, 1997; Wierzbicka, 1998; Kmiecik et al. 2000; Łabuda, 2000a; Mnichowska and Pędziński, 2001; Jadczak et al. 2005).

The aim of this study was to evaluate the most important yield-determining traits of six cultivars and three breeding lines of faba bean harvested for fresh green seeds at processing maturity, using a single harvest of pods. It was essential to trace and compare more important growth stages of faba bean plants and

to determine the abundance of flowering and pod set as well as pod and seed yield per plant.

MATERIALS AND METHODS

Field investigations were carried out in the period 2008–2009 at the Felin Experimental Farm of the University of Life Sciences in Lublin. The experimental material comprised 6 cultivars and 3 breeding lines of faba bean (*Vicia faba* L. var. *major* Harz) which had been obtained from the following seed breeding companies: "SPÓJNIA" Hodowla i Nasiennictwo Ogrodnicze Sp. z o.o. in Nochów: 'Bachus', 'Bonus', 'Basta', R-366/1, R-384, R-383; Polska Hodowla i Nasiennictwo Roślin Ogrodniczych IWARZ-PNOS Sp. z o.o.: 'Jankiel Biały', 'Karmazyn'; and POLAN Hodowla i Nasiennictwo Ogrodnicze Gdańsk-Wieniec Sp. z o.o.: 'Windsor Biały'.

The experiment was set up in a randomized block design in 4 replications on grey-brown podzolic soil, derived from loess deposits, which contained about 1.6% of organic matter. Dressed seeds were sown in the second decade of April at a spacing of 60 × 10 cm, 100 seeds in two rows in a plot 5 m long and 1.20 m wide, that is, with an area of 6.0 m^2. Fertilization was applied based on soil analysis results, while plant protection treatments were performed in accordance with the generally accepted rules for this plant.

The investigations carried out during the growing season involved observations of more important growth stages and their duration as well as plant growth; they also involved biometric measurements of 20 randomly selected plants which included the following traits: plant height, number of branches per plant, number of inflorescences per plant and number of flowers per inflorescence, number of pods per plant: large pods (marketable), small pods (undeveloped), and pods with disease symptoms. Moreover, the following characters were determined: pod and seed weight per plant in faba bean plants harvested once at processing maturity of fresh green seeds. Pod length, width and weight as well as single seed weight were determined on the basis of measurements of 20 marketable pods. The results of the study were statistically analysed using analysis of variance and Tukey's confidence intervals at a significance level of 5%.

The characteristics of weather conditions during the study years and the long-term means for the period 1951–2000 are presented based on the data obtained from the agro-meteorological station of the Laboratory of Agrometeorology, University of Life Sciences in Lublin, located at the Felin Experimental Farm.

RESULTS

The study showed significant differences between the tested faba bean cultivars and breeding lines with respect to their commercially important traits, such as: plant height, number of branches per plant, beginning and duration of flowering as well as number of inflorescences per plant and number of flowers per cluster (Tables 1 and 2). The highest plants (86.9 cm) were found in the cultivar 'Windsor Biały', while the lowest ones (63.3 cm) in the breeding line R-384. Plants of 'Jankiel Biały' produced the highest number of branches (3.5), while the lowest number (2.5) was found in 'Bachus' which was also characterized by the lowest number of inflorescences per plant (32.0). On average, the highest number of inflorescences per plant was recorded for 'Basta' (40.2) and 'Jankiel Biały' (39.3), but the latter one was marked by the lowest number of flowers per cluster (5.6).

The beginning of flowering in faba bean plants was observed at the end of the first decade of June in 2008 and at the turn of the third decade of May and the first decade of June in 2009. At the same time, there were larger differences between the tested treatments as regards the length of the period from emergence to beginning of flowering, which was 26–31 days; this period was the shortest in plants of the breeding line R-384 and the longest in 'Basta'. The beginning of pod set also varied in 2009, as the first pod primordia were observed after 37–45 days from emergence, most quickly in R-384 plants (Table 2).

Under the weather conditions in 2009 (Table 3), high water deficit was observed in the initial period of plant growth directly after seeding, that is, from the middle of April until the middle of May, which resulted in long-lasting (up to 19 days) and uneven plant emergence. The shortage of water during this period contributed to a very slow growth of the plants which reached a height of slightly more than 5 cm in the second decade of May. On the other hand, weather conditions in 2009 were more favourable for the plants during the period from the beginning of flowering and pod set; rainfall was increasingly more frequent, and total rainfall in June was 125.5 mm and exceeded more than twice the long-term mean. This affected the intensity and duration of flowering of the faba bean plants.

The duration of flowering varied between years and was dependent on the studied cultivars and breeding lines. Plants of the breeding lines R-366/1 and R-384 as well as those of the cultivar 'Windsor Biały' showed a clear response to year-to-year variation in weather conditions. In 2009 the duration of flowering in the plants of these cultivars was longer by 7, 8, and 6 days, respectively, compared to flowering duration under the weather conditions in 2008 when there was drought and relatively high temperature from the third decade of May and in June (Table 3).

The results of the present study (Table 4) showed that, on average during the two years of the study, the faba bean plants reached the green maturity stage

(processing maturity of green seeds), using a single harvest when most pods were developed and filled with seeds, after 49–50 days from the beginning of flowering and after 79–81 days from emergence. At the same time, the study also demonstrated that the period from the beginning of flowering and from emergence to harvest was significantly longer in 2009, as compared to 2008, on average by 15 and 13 days, respectively, for the studied cultivars and breeding lines.

The results of this study showed that the number of pods per plant and the structure of pods as well as their dimensions and weight exhibited high variation depending on the cultivar and breeding line as well as depending on the year (Table 5; Fig. 1a, Fig. 1b).

The number of pods per plant was from 4.3 do 10.9, while in 2008 marketable pods accounted for 76.7–88.9% in the total number of pods (Fig. 1a and 1b) and for 74.8–89.8% in 2009. On the other hand, in 2008 the percentage of small undeveloped pods in the total number was 7.0–19.8%, depending on the cultivar and breeding line, averaging 12.3%, whereas in 2009 it was slightly lower and ranged 5.5–17.4%, on average 9.5%. Under the conditions of optimal temperature and adequate water supply to the faba bean plants in 2009, more pods were well developed and filled with seeds.

In 2008 pods with disease symptoms accounted for 1.9 to 5.0% of the total number of pods per plant, while in 2009 it was from 0.7 to 13.5%.

The breeding line R-383 was characterized by marketable pods with the highest weight (47.9 g) and they were also the longest, whereas pods with the lowest weight (25.6 g) were found in the cultivars 'Basta' and 'Karmazyn', the latter cultivar being also marked by the lowest pod length (12.8 cm).

Single seed weight is one of the most important commercial traits of faba bean at green maturity stage. The present study shows that this trait was dependent to the greatest degree on the genetic characters of the plants evaluated and its value was, on average for the study period, from 2.60 g ('Basta') to 3.84 g (line R-384). It should be added that single seed weight in the cultivars 'Bachus' and 'Windsor Biały' as well as in the breeding line R-383 was also high (3.64–3.77 g). Seeds of the other tested cultivars were smaller; however, there is also a demand for smaller faba bean seeds, primarily in faba bean processing for canning and freezing purposes.

One of the most important yield-determining traits of faba bean cultivars is pod and seed weight per plant. Fig. 2 shows that the weight of marketable pods per plants varied, depending on the cultivar and weather conditions during the growing season, and it ranged from 161.0 to 272.4 g. The weight of marketable pods (for shelling) and fresh green seeds was higher in 2009 and averaged 228.9 and 96.1 g, respectively; in that year, the faba bean plants had a longer period of growth and pod filling as well as a longer growing period from emergence to harvest maturity. Among the evaluated cultivars, plants of the cultivars 'Bonus', 'Karmazyn' and 'Windsor Biały' as well as those of the breeding line R-383 distinguished themselves in terms of seed yield in that year. On the other hand, the breeding lines R-366/1 and R-384 were characterized by similar pod and seed yield per plant during the study period.

'Karmazyn', with a ruby red colour of its seeds which they also maintain after cooking, proved to be an extremely interesting cultivar. Plants of this cultivar were characterized by good shoot rigidity, its pods had a medium weight, but were well filled with seeds, and seed yield per plant was similar to that obtained from 'Windsor Biały'.

Table 1
Characteristics of some growth traits of faba bean cultivars and breeding lines

Cultivar or breeding line	Plant height (cm)			Number of branches per plant			Number of inflorescences per plant			Number of flowers per inflorescence		
	2008	2009	Mean	2008	2009	Mean	2008	2009	Mean	2008	2009	Mean
Bachus	64.8	81.2	73.0	2.3	2.7	2.5	30.8	33.1	32.0	6.9	6.4	6.7
Bonus	69.7	84.6	77.2	2.5	2.8	2.7	31.9	34.2	33.1	6.6	6.2	6.4
Basta	71.0	63.1	67.1	3.0	3.2	3.0	40.0	40.3	40.2	7.9	7.2	7.6
R-366/1	71.8	79.6	75.7	2.7	3.4	3.1	30.8	47.0	38.9	6.5	6.9	6.7
R-384	58.9	67.7	63.3	3.2	3.1	3.1	37.5	34.5	36.0	6.6	6.1	6.4
R-383	64.1	78.2	71.2	3.0	2.9	2.9	37.7	37.2	37.5	7.1	5.6	6.4
Jankiel Biały	75.2	79.9	77.6	2.8	4.2	3.5	28.6	49.9	39.3	5.5	5.7	5.6
Karmazyn	74.9	73.9	74.4	2.9	3.8	3.4	29.6	46.4	38.0	6.9	6.3	6.6
Windsor Biały	85.8	88.1	86.9	2.7	2.7	2.7	29.2	39.8	34.5	7.2	6.4	6.8
Mean	70.7	77.4	74.0	2.8	3.2	3.0	32.9	40.3	36.6	6.8	6.3	6.6
$LSD_{0.05}$ cultivar	10.0	10.13		1.07	0.77		11.41	9.90		1.97	1.22	

Table 2
Characteristics of flowering and pod setting of faba bean cultivars and breeding lines

Cultivar or breeding line	Start of flowering					Start of pod set					End of flowering (date)		Flowering duration (days)		
	Date		Number of days after emergence			Date		Number of days after emergence							
	2008	2009	2008	2009	Mean	2008	2009	2008	2009	Mean	2008	2009	2008	2009	Mean
Bachus	9.06.	30.05.	30	28	29	21.06	13.06.	42	42	42	3.07.	25.06.	24	26	25
Bonus	10.06.	30.05.	31	29	30	21.06.	10.06.	42	40	41	3.07.	23.06.	23	24	24
Basta	10.06.	3.06.	31	31	31	25.06.	17.06.	46	45	46	11.07.	3.07.	31	30	31
R-366/1	10.06.	2.06.	31	29	30	22.06.	18.06.	43	45	44	5.07.	4.07.	25	32	29
R-384	10.06.	1.06.	31	26	29	22.06.	12.06.	43	37	40	30.06.	28.06.	20	28	24
R-383	10.06.	31.05.	31	30	31	22.06.	13.06.	43	43	43	1.07.	25.06.	21	26	24
Jankiel Biały	10.06.	1.06.	31	28	30	21.06.	18.06.	42	45	44	30.06.	24.06.	20	23	22
Karmazyn	10.06.	3.06.	31	29	30	23.06.	16.06.	44	42	43	30.06.	28.06.	20	25	23
Windsor Biały	9.06.	30.05.	30	28	29	23.06.	13.06.	44	42	43	30.06.	25.06.	20	26	23
Mean	-	-	31	29	30	-	-	43	42	43	-	-	23	27	25

Table 3
Mean decade air temperature and total rainfall in the experimental field

Month	Decade	Mean decade air temperature (°C)			Mean decade total rainfall (mm)		
		year		long-term mean	year		long-term mean
		2008	2009	1951–2000	2008	2009	1951–2000
March	I	3.4	0.2	-0.7	16.6	15.4	8.4
	II	3.4	0.9	0.4	27.0	28.9	7.4
	III	3.3	3.1	3.0	22.0	25.3	10.1
April	I	7.8	11.4	5.9	17.6	1.1	14.2
	II	9.4	9.3	6.9	35.3	1.8	12.3
	III	10.8	13.5	9.6	2.9	0	14.1
May	I	11.3	13.6	11.6	57.1	3.6	16.6
	II	13.3	13.1	13.6	34.7	34.8	18.3
	III	13.6	14.2	13.7	9.8	32.9	23.5
June	I	18.0	15.3	16.0	0	28.2	20.8
	II	16.4	14.9	16.3	19.6	32.7	21.2
	III	18.8	19.1	17.1	6.3	64.6	23.8
July	I	17.1	19.9	17.4	39.6	15.6	23.5
	II	18.9	20.5	18.2	19.3	9.8	25.7
	III	18.9	19.3	18.0	18.2	31.7	29.0

Table 4
Processing maturity of green seeds (green maturity stage) of faba bean cultivars and breeding lines

Cultivar or breeding line	Processing maturity of green seeds							
	Date		Number of days from start of flowering to harvest			Number of days from emergence to harvest		
	2008	2009	2008	2009	Mean	2008	2009	Mean
Bachus	21.07	27.07	42	58	50	72	86	79
Bonus	21.07	27.07	41	58	50	72	87	80
Basta	23.07	30.07	43	57	50	74	88	81
R-366/1	22.07	27.07	42	55	49	73	84	79
R-384	22.07	27.07	42	56	49	73	83	78
R-383	22.07	27.07	42	57	50	73	87	80
Jankiel Biały	21.07	30.07	41	59	50	72	87	80
Karmazyn	23.07	27.07	43	54	49	74	83	79
Windsor Biały	21.07	27.07	42	58	50	72	89	81
Mean			42	57	50	73	86	80

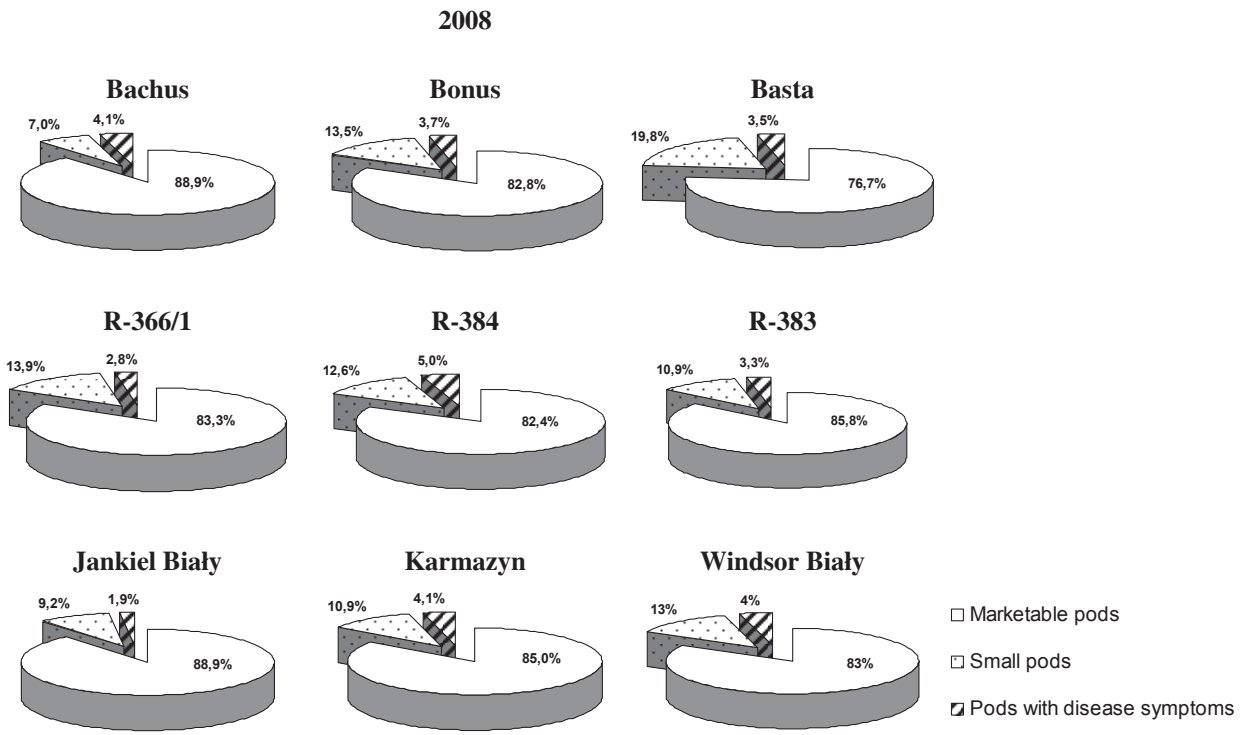

Fig. 1a. Structure of the total number of pods per plant of faba bean harvested at processing maturity of green seeds in 2008.

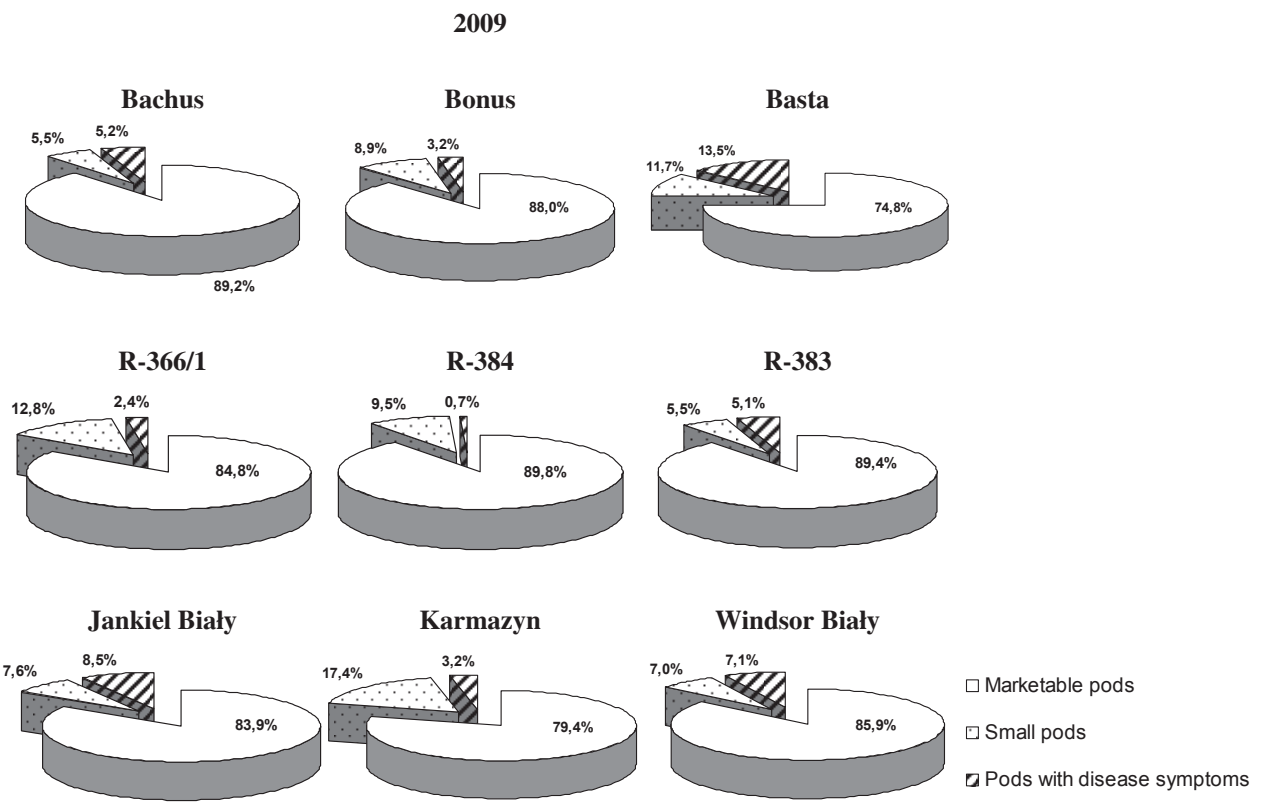

Fig. 1b. Structure of the total number of pods per plant of faba bean harvested at processing maturity of green seeds in 2009.

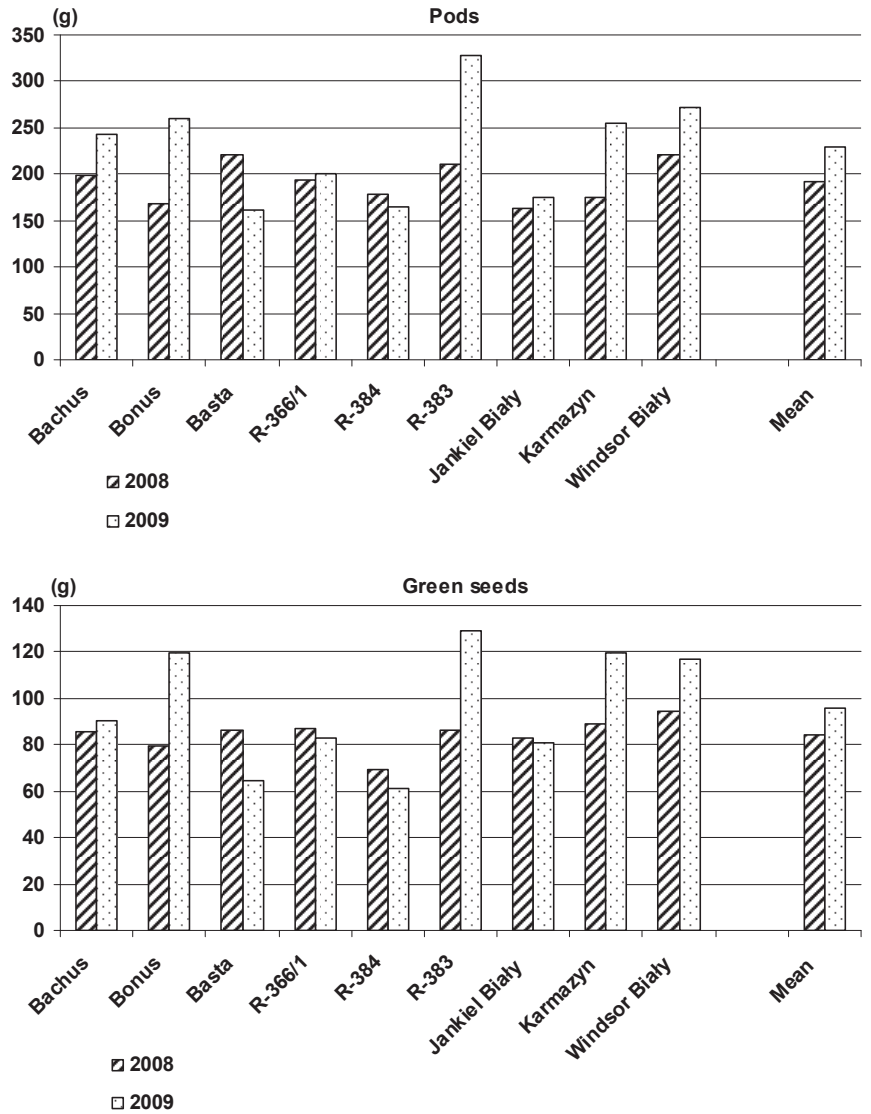

Fig. 2. Fresh weight of pods and seeds per plant of faba bean cultivars and breeding lines.

Table 5
Number of pods per plant and characteristics of faba bean pods and seeds at processing maturity of green seeds

Cultivar or breeding line	Number of pods per plant (range in the years)	Pod length cm			Pod width mm			Pod weight g			Single seed weight g		
		2008	2009	Mean	2008	2009	Mean	2008	2009	Mean	2008	2009	Mean
Bachus	5.4-7.8	15.4	18.4	16.9	27.6	29.7	28.7	39.3	46.5	42.9	3.88	3.66	3.77
Bonus	5.1-10.9	13.1	15.9	14.5	22.3	24.4	23.4	27.3	31.0	29.2	2.99	3.51	3.25
Basta	5.9-9.3	12.2	16.9	14.6	20.4	24.7	22.6	22.5	28.7	25.6	2.11	3.09	2.60
R-366/1	5.4-9.7	12.5	14.2	13.3	23.6	23.2	23.4	25.0	28.8	26.9	2.70	3.27	2.99
R-384	4.9-6.0	13.0	19.5	16.3	26.3	28.8	27.6	31.7	53.0	42.4	3.46	4.21	3.84
R-383	4.9-8.9	15.3	19.7	17.5	28.6	32.2	30.4	42.4	53.4	47.9	3.70	3.59	3.64
Jankiel Biały	4.3-8.3	12.6	14.8	13.7	23.7	24.7	24.2	26.1	25.5	25.8	3.00	3.18	3.09
Karmazyn	4.4-10.3	12.2	13.3	12.8	23.7	24.3	24.0	25.2	25.9	25.6	3.06	2.89	2.97
Windsor Biały	5.1-9.7	13.5	15.7	14.6	26.2	26.8	26.5	34.1	33.9	34.0	4.03	3.50	3.76
Mean	- -	13.3	16.5	14.9	24.7	26.5	25.6	30.4	36.3	33.4	3.21	3.43	3.32
$LSD_{0.05}$ cultivar		1.48	1.67		2.82	2.42		6.48	7.32		0.24	0.50	

DISCUSSION

In the research on creative breeding of faba bean, researchers seek to breed new cultivars with plant traits that exhibit lower sensitivity to variable environmental conditions and are characterized by stable yield. The results of the present study showed significant differences between the faba bean cultivars and breeding lines compared; these differences related to such commercially important traits as: plant height, number of branches per plant, beginning and duration of flowering as well as number of inflorescences per plant and number of flowers per cluster.

In the cultivars 'Jankiel Biały', 'Karmazyn', and 'Windsor Biały' as well as in the breeding line R-366/1, the abundance of flowering of faba bean changed significantly under varying growing conditions in terms of water supply. In these cultivars, the average number of inflorescences produced per plant was 28.6–30.8 when there was a water deficit during the flowering stage, while under the conditions of optimal water supply to the faba bean plants this number was 35–70% higher and amounted to 39.8–49.9.

An earlier study showed that the number of inflorescences per faba bean plant ranged from 27.5 to 34.6 depending on the time of cultivation (Łabuda, 1989), and from 40.1 to 47.1 depending on nitrogen fertilization (Łabuda, 2002), whereas in the years with variable weather conditions this range was 22.0–36.6. The study of Wieryszko-Chmielewska and Chwil (2000) showed that in the presence of lead in soil faba bean plants were characterized by slightly accelerated flowering and, at higher doses of the toxicant (2000 mg × kg^{-1} of soil), lower flowering abundance by 11% compared to the control.

At the same time, it was also demonstrated that the period from the beginning of flowering and from emergence to harvest was significantly longer in 2009, as compared to 2008, on average by 15 and 13 days, respectively, in the tested cultivars and breeding lines. High water deficit was observed in the initial period of plant growth directly after seeding, that is, from the middle of April until the middle of May, which resulted in long-lasting (up to 19 days) and uneven plant emergence. Łabuda (1987) showed that emergence of faba bean plants from the earliest date of sowing in April occurred on average after 20 days and that the sum of temperatures necessary for emergence averaged 225.5°C and was dependent on the cultivar.

The duration of flowering of the faba bean plants varied between years depending on the studied cultivars and breeding lines. Plants of the breeding lines R-366/1 and R-384 as well as those of the cultivar 'Windsor Biały' showed a clear response to year-to-year variation in weather conditions and varying flowering duration.

Variation in the duration of plant growth stages primarily affects the amount and structure of faba bean pod yield, which is clearly dependent on the timing of cultivation and weather conditions (Łabuda, 1989; Sękara and Poniedziałek, 2001; Sękara et al. 2001).

The time of flowering and pod set in faba bean plants belong to the periods of the highest requirement for water. Additionally, the weather pattern and temperature distribution during this period is important, because this largely determines visitation by pollinating insects, as faba bean is considered to be a self- and cross-pollinating plant (Perryman and Marcellos, 1988; Suso et al. 1996; Łabuda, 1997; Szymczak, 2006; Patrick and Stoddard, 2010). The authors of these papers report that allogamy of faba bean contributes to an increased number of pods set and to higher yield. Perryman and Marcellos (1988) claim that insect visits to *Vicia faba* L. at the time when the flowers first open have the greatest effect on pod set, since at this stage foreign pollen is more competitive. Faba bean is one of the legumes of high yield-producing potential, but with the lowest yield stability, which is associated to the greatest extent with large variation in rainfall during the growing season of plants and this applies to different cultivation regions (Karrou and Oweis, 2012).

The number of pods per plant was lower (4.4–5.9) under the conditions of drought and shortened growing period of the plants (73 days from emergence to processing maturity), whereas this number was higher (6.0–10.9) in the case of optimal water supply to the plants and a longer growing period.

The number of pods set per plant and, first of all, the number of marketable pods show high variation in faba bean, which is dependent on the genetic traits of cultivars, cultivation methods, and primarily on weather conditions and effective pollination by insects (Lisiewska and Kmiecik, 1981; Łabuda, 2000 a and b, 2002).

Pod and seed weight and size are varietal characters and in breeding it is important to obtain genotypes sought. Seeds of the breeding line R-384 distinguished themselves in terms of their size at processing maturity; single seed weight was 3.84 g and was higher than in 'Windsor Biały', in the case of which it was 3.76 g.

Suso et al. 1996 report that yield regulation in faba bean is driven by different mechanisms: genetic traits, death of young pods, primordia, and seeds as well as attempts to obtain beans of appropriate size.

CONCLUSIONS

1. The evaluated cultivars and breeding lines of faba bean were characterized by large variations in the most important useful traits.

2. The abundance and duration of flowering as well as the number and weight of pods per plant were clearly modified by weather factors during the growth of plants.
3. The new breeding lines R-366/1 and R-384 as well as the cultivars 'Bachus' and 'Jankiel Biały' were characterized by quite stable pod and seed yield per plant.
4. Single harvesting of faba bean pods at maturity stage of green seeds produced positive results in the case of all cultivars and breeding lines investigated; marketable pods per plant accounted for 75-80% of the total number of pods.

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Kwitnienie i charakterystyka cech użytkowych odmian i rodów hodowlanych bobu *Vicia faba* L. var. *major* Harz

Streszczenie

Badania przeprowadzone w latach 2008–2009 dotyczyły wzrostu, kwitnienia, zawiązywania strąków i plonowania roślin odmian i rodów hodowlanych bobu (*Vicia faba* L. var. *major*). Pomiary biometryczne losowo wybranych 20 roślin obejmowały następujące cechy: wysokość rośliny, liczbę rozgałęzień na roślinie, liczbę kwiatostanów na roślinie i kwiatów w kwiatostanie, liczbę strąków na roślinie: duże (handlowe), małe (niewyrośnięte) i z objawami chorobowymi. Ponadto określono masę strąków i nasion bobu z roślin zbieranych jednorazowo w fazie dojrzałości technologicznej na świeże, zielone nasiona a także długość, szerokość i masę strąka oraz masę 1 nasiona. Oceniane odmiany i rody hodowlane bobu odznaczały się dużym zróżnicowaniem pod względem najważniejszych cech użytkowych. Obfitość kwitnienia, długość okresu kwitnienia oraz liczba i masa strąków z rośliny były wyraźnie modyfikowane przez układ czynników pogody podczas wegetacji roślin. Nowe rody hodowlane R-366/1 i R-384 oraz odmiany Bachus i Jankiel Biały charakteryzowały się dość stabilnym plonem strąków i nasion z rośliny. Zastosowanie jednorazowego zbioru strąków bobu w fazie dojrzałości na zielone nasiona w przypadku wszystkich badanych odmian i rodów hodowlanych dało pozytywne rezultaty, strąki handlowe na roślinie stanowiły 75–80% ogólnej liczby strąków.