Original scientific paper

EVALUATION OF WINTER PROTEIN PEA CULTIVARS IN THE CONDITIONS OF SERBIA

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Summary: There is a widespread opinion that the development of winter cultivars of protein pea could significantly increase its cultivation area, especially in the temperate regions. A small-plot trial was carried out on a chernozem soil at the Experiment Field of the Institute of Field and Vegetable Crops at Rimski Šančevi, including six French and three Bulgarian winter protein pea cultivars. The cultivar 5105 had the earliest date of beginning of flowering (April 16) and the earliest date of harvest (June 11). The cultivars Dove and 5105 had the highest winter survival coefficients, with 0.93 each in the year of 2004/05 and 0.92 each in the year of 2005/06. In average, the highest grain yield was in the cultivars 5174 (6567 kg ha^{-1}) and Dove (6453 kg ha^{-1}), while the lowest grain yield was in the cultivar Frilène (1062 kg ha^{-1}).

Key words: evaluation, grain yield, protein pea, low temperatures tolerance, winter cultivars.

INTRODUCTION

Growing protein pea (*Pisum sativum* L.) represents one of the least expensive and one of the most quality answers to a constant demand for plant proteins in animal husbandry (Maxted & Ambrose, 2000), as well as an excellent addition to soybean meal in the years with less favourable conditions for the production of soybean grain (Mikić et al., 2003). In an agronomic sense, protein pea means such feed pea cultivars that are used for grain exclusively, with white flowers, round grains, yellow-white or blue-green testa and very low or low content of anti-nutrititional factors, with an exception of the cultivars of older generations, with violet flowers and marble testa (Carrouée, 1993; Mihailović et al., 2004a).

Protein pea was completely unknown in Serbia up to three decades ago, since feed pea had been traditionally grown only in the form of forage pea (Mihailović et al., 2005c). All Serbian cultivars of protein pea have been developed in the Institute of Field and Vegetable Crops in Novi Sad and, regarding the time of sowing, belong to spring types (Mihailović et al., 2007).

There is a rather widespread and mostly accepted opinion that the development of winter cultivars of diverse grain legumes, primarily protein pea and faba bean (*Vicia faba* L.), could significantly increase the cultivation area of these crops, especially in the temperate regions (Duc, 1997). Such winter cultivars owe their frost resistance to a delayed floral initiation (Etévé & Derieux, 1982; Lejeune-Hénaut et al., 1999), reach full maturity and are ready for harvest before winter wheat (Mihailović et al., 2004b) and have higher and more stable grain yields (Lejeune-Hénaut, 2000) with a higher crude protein than in the spring cultivars (UNIP & ITCF, 1995).

The main goal of the study was to determine the possibility of growing winter protein pea cultivars in the conditions of Serbia.

MATERIALS AND METHODS

A small-plot trial was carried out on a chernozem soil at the Experiment Field of the Institute of Field and Vegetable Crops at Rimski Šančevi. The trial included six French and three Bulgarian winter protein pea cultivars, namely Champagne, Frilène, Frijaune, Dove, 5105, 5174, Vesela, No. 11 and Drujba, with the Serbian spring protein pea cultivar Javor as a control, being one of the most widely distributed protein pea cultivars in the country.

All nine cultivars were sown by hand in early October, at a crop density of about 135 viable seeds m^{-2}, while the control cultivar was sown in early March.

There were monitored the following characteristics:

- dates of beginning of flowering, with 10 % of all plants of one cultivar in flower;
- dates of harvest, with the grains of firstly formed pods in full maturity;
- number of plants before winter (m^{-2}), usually in late October;
- number of plants before harvest (m^{-2}), usually at the stage of grain filling;
- winter survival coefficient, calculated as the ratio of the previous two characteristics;
- grain yield (kg ha^{-1}), measured at a moisture level of 14 %.

The results of the study were processed by analysis of variance (ANOVA) with the Least Significant Difference (LSD) test applied and using the computer software MSTAT-C.

RESULTS AND DISCUSSION

Average monthly temperatures. As compared to a long-term average, the average monthly temperatures during the two years of testing winter protein pea cultivars at Rimski Šančevi were generally at the same level, with 2004/05 slightly colder (Table 1). It is noteworthy that both 2004/05 and 2005/06 were characterised by warmer average monthly temperatures in the two autumn months and December. The most favourable month for checking the tolerance to low temperatures for the nine winter protein pea cultivars was February, with -4 °C in 2004/05 and 1 °C in 2005/06 in comparison with the long-term average of 2 °C, followed by March 2004/05, with 4 °C in comparison with the long-term average of 6 °C.

Date of beginning of flowering. In average, the cultivar 5105 had the earliest date of beginning of flowering (April 16), while the control cultivar Javor had

the latest date of beginning of flowering (May 21). In the year of 2004/05, the earliest date of beginning of flowering was in the cultivar 5105 (April 12), while the latest date of beginning of flowering was in the control cultivar Javor (May 22). In the year of 2005/06, date of beginning of flowering varied between April 12 in the cultivar 5105 and May 20 in the control cultivar Javor (Table 2).

Table 1. Average monthly temperatures (°C) in 2004/05 to 2005/06 at Rimski Šančevi

Year	Month										Average
	X	XI	XII	I	II	III	IV	V	VI	VII	
2004-05	14	7	3	0	-4	4	12	17	19	21	9
2005-06	13	5	3	-1	1	6	13	16	20	23	10
Long-term average	12	6	2	-1	2	6	11	17	20	21	10

Date of harvest. In the year of 2004/05, date of harvest ranged from June 9 in the cultivar 5105 to July 1 in the control cultivar Javor (Table 2). In the year of 2005/06, the earliest date of harvest was in the cultivar 5105 (June 14), while the latest date of harvest was in the cultivar Champagne (July 1). In average, the cultivar 5105 had the earliest date of harvest (June 11), while the control cultivar Javor had the latest date of harvest (July 1), closely followed by the cultivar Champagne (June 30).

Table 2. Dates of beginning of flowering and harvest in nine winter protein pea cultivars and a control cultivar (c) in 2004/05 to 2005/06 at Rimski Šančevi

Cultivar	Date of beginning of flowering			Date of harvest		
	2004/05	2005/06	Average	2004/05	2005/06	Average
Champagne	May 10	May 8	May 9	July 1	June 30	June 30
Frilène	April 29	April 18	April 23	June 12	June 17	June 14
Frijaune	April 28	April 18	April 23	June 12	June 17	June 14
Dove	April 27	April 17	April 22	June 17	June 17	June 17
5105	April 20	April 12	April 16	June 9	June 14	June 11
5174	April 23	April 15	April 19	June 20	June 18	June 19
Vesela	April 27	April 20	April 23	June 13	June 18	June 15
No. 11	April 29	April 20	April 24	June 11	June 18	June 14
Drujba	April 30	April 24	April 27	June 24	June 22	June 23
Javor (c)	May 22	May 20	May 21	July 5	June 29	July 1

Number of plants before winter. In average, the greatest number of plants before winter was in the cultivars Champagne, 5105 and 5174 (130 plants m^{-2}), while the smallest number of plants before winter was in the cultivar Vesela (124 plants m^{-2}). Number of plants before winter ranged from 115 plants m^{-2} in the cultivar No. 11 in the year 2004/05 to 132 plants m^{-2} in the cultivars Dove in the year of 2004/05 and 5105 in the year of 2004/05. There were significant differences at the both levels of 0.05 and 0.01 in number of plants before winter between the examined cultivars in both years (Table 3).

Number of plants before harvest. With significant differences at both levels of 0.05 and 0.01 between the examined cultivars in both years, number of plants before harvest varied between 20 plants m-2 for the cultivar Frilène in the year of

2004/05 and 123 plants m^{-2} in the cultivar Dove in the year of 2005/06 (Table 3). In average, the cultivar Dove had the greatest number of plants before harvest, with 122 plants m^{-2}, while the cultivars Frilène and Vesela had the smallest number of plants before harvest, with 29 plants m^{-2} and 30 plants m-2.

Table 3. Number of plants before winter (NPW), number of plants before harvest (NPH) and winter surviving coefficient in nine winter protein pea cultivars and a control cultivar (c) in 2004/05 to 2005/06 at Rimski Šančevi

Cultivar	Year								
	NPW (m^{-2})			NPH (m^{-2})			WSC		
	2004/05	2005/06	2004/06	2004/05	2005/06	2004/06	2004/05	2005/06	2004/06
Champagne	131	128	130	107	112	110	0.82	0.87	0.85
Frilène	124	128	126	20	37	29	0.16	0.29	0.23
Frijaune	124	129	127	44	48	46	0.36	0.37	0.37
Dove	132	130	131	123	120	122	0.93	0.92	0.93
5105	129	132	130	120	121	120	0.93	0.92	0.93
5174	129	130	130	106	119	113	0.82	0.92	0.87
Vesela	124	124	124	26	34	30	0.21	0.28	0.24
No. 11	115	124	120	50	50	50	0.44	0.40	0.42
Drujba	127	123	125	74	69	72	0.58	0.56	0.57
Javor (c)	-	-	-	104	112	108	-	-	-
$LSD_{0.05}$	6			7			0.09		
$LSD_{0.01}$	8			10			0.12		

Table 4. Grain yield (kg ha^{-1}) in nine winter protein pea cultivars and a control cultivar (c) in 2004/05 to 2005/06 at Rimski Šančevi

Cultivar	Year		
	2004/05	2005/06	2004/06
Champagne	3692	3338	3515
Frilène	600	1523	1062
Frijaune	1104	2240	1672
Dove	5633	7272	6453
5105	3720	4175	3948
5174	6964	6170	6567
Vesela	1209	1984	1597
No. 11	1440	1842	1641
Drujba	2368	2353	2360
Javor (c)	5020	5640	5330
$LSD_{0.05}$	277		
$LSD_{0.01}$	369		

Winter survival coefficient. The cultivars Dove and 5105 had the highest winter survival coefficients, with 0.93 each in the year of 2004/05 and 0.92 each in the year of 2005/06, while the cultivars Frilène and Vesela had the lowest winter survival coefficients, with 0.16 and 0.21 respectively in the year of 2004/05 and 0.29 and 0.28 in the year of 2005/06 (Table 3). With a winter survival coeffi-

cient of 0.85, the essentially double-purpose cultivar Champagne proved its prominent winter hardiness among both forage and protein pea cultivars (Mihailović et al., 2005a).

Grain yield. In the year of 2004/05, the variation in grain yield was broader and it ranged from 600 kg ha^{-1} for the cultivar Frilène to 6964 kg ha^{-1} for the cultivar 5174. In the year of 2005/06, the variation in grain yield was narrower and it varied between 1523 kg ha^{-1} for the cultivar Frilène to 7272 kg ha^{-1} for the cultivar Dove. There were significant differences at the both levels of 0.05 and 0.01 in grain yield between the examined cultivars in both years (Table 4). In average, the highest grain yield was observed for the cultivars 5174 (6567 kg ha^{-1}) and Dove (6453 kg ha^{-1}), while the lowest grain yield was in the cultivar Frilène (1062 kg ha^{-1}). The cultivars 5174 and Dove produced a higher grain yield in both years in comparison with the control cultivar Javor, confirming the preliminary results on their performance (Mihailović et al., 2005b).

CONCLUSIONS

The obtained results provide a solid base for an opinion that there are winter protein pea cultivars with a great potential for both tolerance to low temperatures and high and stable grain yields in the prevailing conditions of Serbia, especially its northern Province of Vojvodina.

The study results also open possibilities for establishing the first Serbian breeding programme on winter protein pea that may result in increasing the growing area of pea in general and the creating novel prospects in its utilisation.

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