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THE EFFECT OF VETCH SEED SIZE ON THE SEED QUALITY AND ON SEEDLING VIGOR

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Abstract

Common vetch (*Vicia sativa*L.) in Serbia has the highest economic importance of the species *Vicia*. It is mostly cultivated jointly with cereals (oats, wheat, and triticale). It is rarely grown in pure culture due to flattening.

Producers have noticed that the market offer various sized seed. We decided to examine the connection between seed size with seed germination and vigor.

The paper presents two years results (2012 and 2013), of two cultivars of vetch seed (*Vicia sativa L*), and the three seed lots of each.

Seeds of each lot are divided into three fractions (C- small<3.5 mm; B - medium 3.5 to 5mm: A- large>5 mm. The germination and vigor of seeds are tested from all fractions (A, B, C).Germinated seeds were done in hot bed between the filter paper at 20°C in the dark; energy of germination was checkedon the fifth day, and the germination of the fourteenth day, in accordance with the ISTA rules.

Seed size had a significant impact both on the germination, and on the seedling vigor. The impact of the year, the party of seed and the varieties had no significant effect ($P \leq 0.05$). Between seed germination and seedling vigor was found high correlation (r).

Key words: *seed size, seed germination, seedling vigor, Vicia sativa*

Introduction

Common vetch (*Vicia sativa*) is a forage species with a long tradition of cultivation in Southeast Europe. The traditional way of use is the drying and haymaking. In recent years, often used for making haylage or silage, this has contributed to advances in the technology of conservation. In both modes of use,lodging is the problem in the phase of collecting. Therefore, it is grown mainly with cereals (wheat, oats, triticale), which increases the yield and partly solves the problem of collection but also the need to establish the optimum relationship between vetch and cereals (Mišković 1996; Yucel, andAvci, 2009; Karagićet al., 2011). For the projected ratio of legume andcereals, seed germination and seedling vigor (initial growth of stems and radicles) are of high importance.

On the other hand, the size of the seed is an important physical quality characteristic that often affect the initial growth of seedlings and in some cases on germination. For example, the leading agricultural crops (maize, rice) size of the seeds has been strongly influenced by genetics. Variation in seed size is due to the flow of nutrients to the seed in the mother plants therefore depending on the circumstances where the seed is located.

In literature there are a wide range of different effects of seed size on seed germination, however, these results differ substantially between species in the literature is insufficient data on the results of research of influence seed size on germination and seedling vigor beans(Kaydanand Yagmur, 2008;Kakhkiet al., 2008; Mut andAkay, 2010; Ambikaet al., 2014).The effect of vetch seed size on germination and vigor is not sufficiently explored, especially in Serbia

Therefore, the aim of this study was to determine the influence of seed size on germination and vigor, which would facilitate the choice of varieties to farmers according to size of seed. This would further determine the direction of breeders in creating new varieties.

Material and methods

In eastern Serbia was taken the seed of vetch (*Vicia sativa*),near Zaječar, 139 m asl, 43°58'N 22°18'E; with three lots (lot factor) of two cultivars (Neoplanta and Ovcepoljska, factor variety), for two years (2012 and 2013). Then the seeds are grouped into three fractions (C - small<3.5 mm; B - medium 3.5 to 5mm: A - large> 5 mm). Seed germination (%) was testedin the hot bed filter paper; 20°C - dark, fourteenth day was checked total seed germination (ISTA rules, 2003). By measuring each seedling (stem length – cm; radicle length – cm; fresh seedling weight- g) vigor was determined.

Statistical Analyses. Data were evaluated by analysis of variance (ANOVA) with Minitab 16.1.0 Statistics software package. When the *F*-test was significant, means were separated by Duncan's multiple range test at $p \leq 0.05$. An arcsine square-root transformation was performed on data percent. The correlation (r) between traits was established employing the Pearson's Correlation Test.

Results and discussion

Effect of variety, the seed lot and their interaction had no significant effect (F test; P≥0.05) on germination and vigor (Table 1). The reason is probably similar climatic conditions in 2012 and 2013 (table not shown) during critical phases of seed quality (filling, maturing and seed harvesting). Also, during both years in both varieties were applied the same breeding technology. The seed lot has no significant effect on germination in the grass species of *F. pratensis*, *F. arundinacea*, *F. rubra*, *D. glomerata* (Stanisavljević et al., 2013, 2014).

On the other hand, seed size showed a significant influence on seed germination and seedling vigor (Table 2). Between germination of large fractions (A 95%) and middle fractions (93% B), difference of 2% was not statistically significant (P≥0.05). Between middle-fractions (B) and fine fractions (C) difference of 3% was not statistically significant (P≥0.05). But, between the large (A) and fine fractions (C), achieved the difference of5%, which was statistically significant (P≤0.05).

The results ofbetter seed germination in larger seeds are consistent with the results obtained by Kaydan and Yagmur, 2008 with triticale; Kakhki et al. (2008)with wheat;Mut and Akay(2010)with oats and Sulewska et al.(2014)with maize. Overall, we should expect stronger initial seedling growth (vigor) because of higher feed into larger seed, which was necessary for the initial growth of seedlings.

In the fodder production, vigor (initial growth stems, radicles, and seedling weight) have high importance for the establishment of relations projected in grass-legume forage mixtures (Stanisavljević et al. 2011, 2013, 2014).

Table1. Results from analysis of variance (ANOVA) for: germination (G) and vigor,Seedling[stem(S), radicle (R), seedlingweight (SW)]. Sources of germination and variation include: year (Y), cultivar (C), lot (L) seed size (SS).

Source	G	Seedlingvigor		
		S	R	SB
Y	ns	ns	ns	ns
C	ns	ns	ns	ns
L	ns	ns	ns	ns
SS	*	***	**	**
Interactions				
Y× C	ns	ns	ns	ns
Y× C	ns	ns	ns	ns
Y× L	ns	ns	ns	ns
Y×SS	ns	ns	ns	ns
C ×L	ns	ns	ns	ns
C ×SS	ns	ns	ns	ns
L × SS	ns	ns	ns	ns
Y ×C× L	ns	ns	ns	ns
Y ×C× SS	ns	ns	ns	ns
Y ×L× SS	ns	ns	ns	ns
C × S × SS	ns	ns	ns	ns
Y ×C× L× SS	ns	ns	ns	ns

ns:Notsignificant*F* tests at the $P > 0.05$ level of significance.
*Significant *F* tests at the $P \leq 0.05$ level of significance.
**Significant *F* tests at the $P \leq 0.01$ level of significance.
***Significant *F* tests at the $P \leq 0.001$ level of significance.

In our studies, from seed fraction A, rising ofstems (24.52cm), radicles (15.24cm) and weight of seedlings (40.26g) are significantly stronger compared to seedlings resulting from seed fraction B (22.87cm stem, 2.14cm radicle, seedling weight 36.12g). Also, vigor in fraction B was significantly (P≤0.05) higher than seedlingvigor obtained from fraction C (20.23cm stem, 13.15cm radicle, seedling weight 31.97g); (Table 2). The results are consistent with general conclusion that, in agricultural plant species higher seed weight gives stronger seedling which is advantageous, especially in the initial rise (Ambika et al., 2014).

Table 2. Effect of seed size on germination and vigor (average of two years, two varieties and the three seed lots).

Seed size	Germination %	Seedling vigor		
		Stem length, cm	Radicle length, cm	Fresh seedling weight g
A	95±0.363a	24.52±0.399a	15.24±0.301a	40.26±0.471a
B	93±0.425 ab	22.87±0.402b	14,02±0.344b	36.12±0.524 b
C	90±0.492 b	20.23±0.443c	13,15±0.376c	31.97±0.528 c

Different letters within the same column note significant differences (Duncan's Multiple Range test, $P \leq 0.05$). Values are mean ± standard error of the mean

Table 3.Correlation coefficients (r) between the studied traits

		Stem length (II)	Radicle length (III)	Seedling weight (IV)
Large	Germination (I)	0.720***	0.630***	0.636***
	II	-	0.596***	0.603***
	III	-	-	0.567***
Medium	Germination (I)	0.648***	0.525***	0.503**
	II	-	542***	0.529***
	III	-	-	0.507**
Small	Germination (I)	0.504**	0.476**	0.482**
	II	-	0.447**	0.424*
	III	-	-	0,409*

Statistical significance level: *P≤ 0.05, ** *P*≤ 0.01, *** *P*≤ 0.001.

In the largest seed fractions (A) between germination and seedling vigor achieved the strongest correlation coefficient (r = 0.720 to 0.630, P ≤ 0.001;Table 3). Also, the germination of seed medium fraction (B) has achieved the same interdependence with vigor (r = 0.648 to 0.503; P ≤ 0.001). Between radicle length and seedling weight, correlation coefficient was not so high (r = 0.507; P ≤ 0.01).
Seed germination of fractions C, with all tested parameters of vigor, has also achieved positive, but lower dependence (r = 0.504 to 0.476; P ≤ 0.01). From this fractions, the lowest interdependence achieved between the weight of seedlings and radicle length (r = 0.409; P ≤ 0.05) and seedling weight and stemlength (r = 0.424, P ≤ 0.05;Table 3).

Conclusion

Large vetch seeds had a 5% higher germination than the small seeds and 2% higher germination than medium seeds. Large seedsachieved significantly stronger seedling vigor (stem 24.52cm,radicle 15.24cm, and weight of seedlings 40.26g) than medium seeds(stem 22.87cm, 14.2cm radicle, seedling weight of 36.12g.). Seedlings from small seedshad significantly lower vigor (stem of 20.23cm, radicle of 13.15cm, seedling weight of 31.97g.) thanmedium seeds.
Manufacturers prefer the larger seeds for better and stronger seedling vigor under field conditions. It is necessary to bear in mind the negative side of larger seeds, that it increases the sowing rate necessary for the realization of the optimum number of plants per unit area, which affects the price increase.

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References

Ambika S.,Manonmani V.,Somasundaram G. (2014). Review on Effect of Seed Size on Seedling Vigour and Seed Yield.Research Journal of Seed Science, 7, 31–38.
ISTA (2003).International Rules for Seed Testing, Edition 2003 ISTA, Bassersdorf.
Kakhki T., Kazemi M., &Tavakoli H. (2008).Analysis of seed size effect on seedling characteristics of different types of wheat (Triticumaestivum L.) cultivars.Asian Journal of Plant Sciences, 7 (7), 666–671
Karagić Đ., Vasiljević S., Katić S., Mikić A., Milić D., Milošević B., Dušanić N. (2011). Yield and quality of winter common vetch (Vicia sativa L.) haylage depending on sowing method.Biotechnol Anim Husbandry, 27, 1585–1594.

Kaydan D., and Yagmur M. (2008).Germination, seedling growth and relative water content of shoot in different seed sizes of triticale under osmotic stress of water and NaCl. African Journal of Biotechnology, 7, 2862–2868.
Mišković B. (1986): Krmnobilje, Naučnaknjiga, Beograd, 323.
Mut Z., Akay H. (2010). Effect of seed size and drought stress on germination and seedling growth of naked oat (Avena sativa L.). Bulgarian Journal of Agricultural Science, 16 (4), 459–467
Stanisavljević R., Đokić D., Milenković J., Đukanović L., Stevović V., Simić A., Dodig D. (2011). Seed germination and seedling vigour of Italian ryegrass, cocksfoot and timothy following harvest and storage.Ciencia e Agrotecnologia, 35, 1141–1148.
StanisavljevićR., MilenkovićJ., ĐokićD., TerzićD., PetrovićM., ĐukanovićL., Dodig D. (2013). Drying of meadow fescue seeds of different moisture contents: Changes in dormancy and germination.Plant Soil and Environment, 59, 37–43.
Stanisavljević R., Đokić D., Milenković J., Terzić D.,Stevović V,. Tomić D., Dodig D. (2014). Drying of forage grass seed harvested at different times and its utility value in sowing periods. Zemdirbyste-Agriculture, 101, 169–176.
Sulewska H., Smiatacz K., Szymanska G., Panasiewicz K., Bandurska H., Glowicka-Woloszyn R. (2014). Seed size effect on yield quantity and quality of maize (Zea mays L.) cultivated in South East Baltic region.Zemdirbyste-Agriculture,101(1), 35–40.
Yucel C., and M. Avci. (2009). Effect of different ratios of common vetch (Vicia sativa L.)-triticale (TriticosecaleWhatt) mixtures on forage yields and quality in Cukurova plain in Turkey. Bulgarian Journal of Agricultural Science, 15(4), 323–332.