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GERMINATION AND VIGOR OF SOYBEAN SEED PRODUCED UNDER DIFFERENT AGRO-METEOROGICAL CONDITIONS
KLIJAVOST I VIGOR SEMENA SOJE PROIZVEDENOG U RAZLIČITIM AGROMETEOROLOŠKIM USLOVIMA

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ABSTRACT

International seed trade considers seed germination as the main indicator of the seed quality. *Different results of seed germination under laboratory conditions and emergence in the field encouraged the development of the concept of the seed vigor and the term of vigor.* Seed viability or vigor presents a set of those traits that affect seed germination and *the* establishment of strong and healthy seedlings under different environmental conditions. *The aim of this work was to determine the effect of locality and production year on germination and vigor of soybean seed. The testing was performed on 6 soybean varieties (Valjevka, Bojana, Balkan, Novosađanka, Vojvođanka i Morava) produced in the towns of Inđija and Vrbas in 2009 and 2010. The seed germination of all samples was determined by using standard laboratory and vigor tests (Cold test and Accelerated aging test). When the standard laboratory test was applied the seed germination of all tested varieties produced in 2009 in Inđija ranged from 78% to 87%, and from 94% to 99% in Vrbas. The germination of seeds produced in 2010 in both localities was higher in all tested varieties in relation to 2009. When the accelerated aging test was applied the germination of seeds produced in Inđija in 2009 was statistically significantly lower (67-85%) in all tested varieties in comparison to seed germination obtained by the standard laboratory test (78-87%). The seed germination obtained by the application of the cold test was statistically significantly lower (25-90%) for the seed produced in Inđija in comparison to the value obtained for the seeds produced in Vrbas (80-97) for both years of production.*

***Key words**: soybean, seed germination, seed vigour, production terms.*

REZIME

Međunarodna trgovina semena, kao osnovni pokazatelj kvaliteta uzima klijavost semena. Različiti rezultati ispitivanja klijavosti semena u laboratorijskim uslovima i nicanja u polju podstakli su razvoj koncepta životne sposobnosti semena i pojma vigora. Životna sposobnost semena ili vigor predstavlja skup onih osobina semena koje utiču na klijavost semena i formiranje snažnog i zdravog ponika u različitim uslovima spoljašnje sredine. Cilj rada je bio da se utvrdi uticaj lokaliteta i godine proizvodnje na klijavost i vigor semena soje. Ispitivanja su izvršena na 6 sorata soje (Valjevka, Bojana, Balkan, Novosađanka, Vojvođanka i Morava) proizvedenih u Inđiji i Vrbasu u 2009 i 2010. godini. Kod svih uzoraka utvrđena je klijavost semena primenom standardnog laboratorijskog metoda i vigor testova (hladni test i test ubrzanog starenja). Primenom standardnog laboratorijskog metoda klijavost semena, kod svih ispitivanih sorata na lokalitetu Inđija, proizvedenih u 2009. godini, se kretala od 78% do 87%, a na lokalitetu Vrbas od 94% do 99%. Klijavost semena proizvedenog u 2010 godini, na oba lokaliteta je bila veća, kod svih ispitivanih sorti, u odnosu na 2009. godinu. Primenom testa ubrzanog starenja klijavost semena proizvedenog na lokalitetu Inđija u 2009. godini, kod svih ispitivanih sorata je bila statistički značajno niža (67-85%) u odnosu na klijavost semena dobijenu standardnim laboratorijskim metodom (78-87%). Klijavost semena dobijena primenom hladnog testa, u obe godine proizvodnje, na lokalitetu Inđija (25-90%) je bila statistički značajno niža u odnosu na vrednosti dobijen za seme proizvedeno na lokalitetu Vrbas (80-97).

***Ključne reči**: soja, klijavost semena, vigor semena, agroekološki uslovi.*

INTRODUCTION

Soybean is considered to be one of the most significant industrial plants due to its protein content which ranges from 35 to 40%, and it contains approx. 20% of oil, and thus is widely used in human and animal nutrition. The seed germination is used as the basic quality indicator in the international seed trade. Different results of seed germination obtained under laboratory conditions, and field emergence have encouraged thedevelopment of the concept of seed vigour and the term of vigour. Seed viability or vigour presents a set of traits that affect seed germination and the formation of strong and healthy seedlings under different environmental conditions (ISTA, 2010). The amount and distribution of rainfall and temperature during the growing season exert a significant influence on yield, seed quality and its vigour (*Balešević-Tubić et al., 2001; Avila et al., 2003*). The aim of this paper was to determine the germination and seed viability of different soybean genotypes, produced at two locations during 2009 and 2010.

MATERIALS AND METHODS

The seed was produced during 2009 and 2010 at two different locations in Inđija and Vrbas. Six commercial varieties from different maturity groups (Valjevka and Bojana – maturity group O; Balkan and Novosađanka maturity group I; Vojvođanka and Morava maturity group II) were included in the trial. The seed germination was determined by using standard laboratory tests, and the seed vigor by using different vigour tests such as the accelerated aging test, and the cold test. These tests were done in the Laboratory for Seed Testing, the Institute of Field and Vegetable Crops, in Novi Sad. In the standard laboratory test, samples of 4 x 100 seeds were tested. Sand was used as a substarte, and the duration of testing was 8 days at 25^{o}C. After this period germination was determined (ISTA, 2009). In the accelerated aging test samples of 4 x 50 seeds were tested. The seed was first exposed to the temperature of 41^{o}C and the relative humidity of 100% during a 96-hour period. After this period the seed was

germinated under optimal conditions, as in standard germination tests, and the seed germination was determined (ISTA, 2009). In cold test, four replicates of 100 seeds were tested. The mixture of soil and sand (2:1) was used as substrate. The seed was first exposed to the temperature ranging from 5-10°C, during a seven-day period. After this period the samples were placed in the germination chamber at 25°C, and after four days the seed germination was determined (*Hempton and Te Krony, 1995*). Obtained results were processed statistically using analysis of variance (*Hadživuković, 1991*) and graphically presented.

RESULTS AND DISCUSSION

The germination of seed produced in 2009 at Indjija locality was determined by using the standard laboratory test, and it ranged from 78-87% (Graph 1). The greatest germination, statistically significant was found in the variety Novosadjanka, while among other tested varieties no statistically significant differences were found. The seed of all tested varieties was produced in the same year, but at the site of Vrbas had significantly higher germination in relation to the values obtained at the site of Inđija. The germination obtained in Vrbas ranged from 94-99%. Statistically significant differences appeared between Valjevka (94%) on the one, and Bojana and Vojvodjanka (99%) on the other hand. The seed produced in Inđija in 2010 had germination ranging from 82-95%. The lowest germination statistically significant was obtained for Balkan (82%), and Bojana (83%) varieties. The germination of seed produced in Vrbas ranged from 88-98%. The lowest germination statistically significant values were obtained for Balkan (88%), Valjevka (93%) and Morava (90%) varieties. The germination of seed of all varieties in both years of testing was greater than 75%, which was the minimum value of the tested parameter, prescribed by the Rule on Quality of Seed of Agricultural Plants (Official gazette of SFRY 47/87). Unfavourable weather conditions prior to harvest cause lower quality of soybean seed, because seed ripen under adverse conditions such as high temperature or high humidity caused by frequent rain. The amount of rainfall in 2010 year was higher compared to 2009, which affected the germination of seeds at the site of Inđija. At the time of seed formation and maturation in 2009, there was significantly lower rainfall, which affected the quality of seed. Lower rainfall quantity with somewhat higher temperature during the July – September period exerted negative influence on the tested parameters at the site of Indjija in relation to the site of Vrbas.

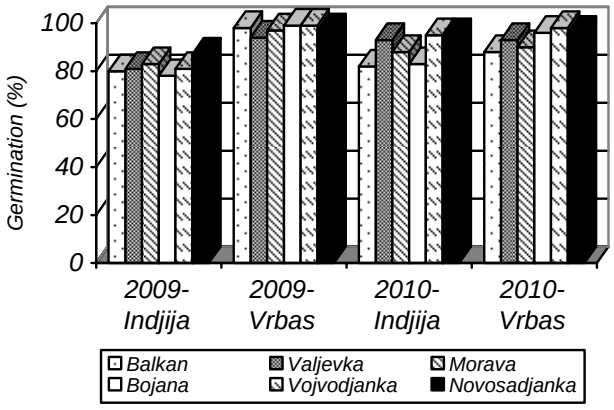

Fig. 1. Soybean seed germination determined using standard laboratory method for different location, years and varieties

The highest statistically significant value was obtained in Novosadjanka variety (85%) by means of the accelerated aging test in 2009 at the site of Indjija, and the lowest ones for Balkan (67%) and Vojvodjanka (70%) varieties (Fig. 2). The germination of seeds produced at the site of Vrbas ranged from 86% in the variety Balkan up to 98% in the variety Novosađanka. The difference between these two values was statistically significant. The seed germination was statistically significantly higher in Novosadjanka variety (96%) in relation to all other tested varieties in 2010 at the site of Inđija. The lowest value was obtained in Bojana variety (86%). The highest value of the tested parameter was determined in Bojana variety (95%) at the site of Vrbas, and the lowest one in Balkan variety (88%). The seed germination determined by means of the standard laboratory test, and the accelerated aging test was influenced by unfavourable meteorological conditions in 2009, which decreased the quality of seed.

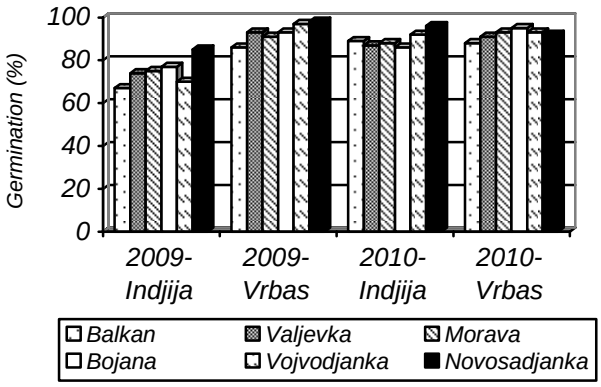

Fig. 2. Soybean seed germination determined by application of accelerated aging test for different location, years and varieties

Nowadays, the accelerated aging test is one of the most commonly used tests for seed vigour testing, mainly because it showed good correlation with the emergence in the field (*Lovato et al., 2005*). In addition to good correlation with the emergence in the field, this test is successfully used in the assessment of seed longevity i.e. selection of seed lots that can be successfully stored for planting in the following year (*TeKrony, 2001; Balešević-Tubić et al., 2010*) the ISTA standardized method for soybean seed testing in 2007. The germination of seed determined by application of the cold test in 2009 at the site of Inđija ranged from 25-58% (Fig. 3). The highest statistically significant value was determined in Vojvodjanka variety, while the lowest one was determined in Balkan variety. There were statistically significant differences among other tested varieties. The germination of seed was significantly higher and ranged from 80-97% at the site of Vrbas. The highest values were obtained in Valjevka and Novosadjanka varieties. The lowest statistically significant value was obtained in Morava variety. The germination of seed produced at the site of Inđija in 2010 ranged from 72-90%. Higher statistically significant values were obtained in Vojvodjanka and Novosadjanka varieties. At the site of Vrbas the lowest statistically significant value was obtained in Morava variety (86%) in relation to other tested varieties. AOSA (2002) mentioned that the application of the cold test can be used to assess the physiological seed damage caused by frost and drought. The decreased quantity of rainfall at the site of Inđija caused extremely low germination determined by means of the cold test. Seed produced under unfavourable conditions at the time of formation and maturation of seed has decreased viability, and is not recommended for early sowing, when conditions for emergence are unfavourable because it would lead to unsatisfactory stand density influencing the yield. Lower values of seed germination determined by the applied cold test were obtained for seed produced under irrigation in comparison to the seed produced under dry land farming (*Vujaković et al., 2008*).

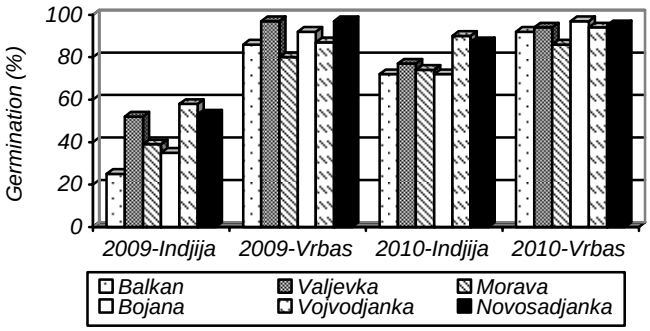

Fig. 3. Soybean seed germination determined using cold test for different location, years and varietes

CONCLUSION

On the basis of the obtained results the following conclusions can be made:

The germination of seed of all tested varieties determined by using standard laboratory tests at the site of Inđija produced in 2009 was lower in relation to germination of soybean varieties produced at the site of Vrbas. The germination of seed determined by using accelerated aging tests at the site of Inđija in 2009 was statistically significantly lower in relation to the seed germination determined by standard laboratory tests. The germination of seed determined by application of cold tests at the site of Inđija in both production years was statistically significantly lower in relation to the values obtained for seed produced at the site of Vrbas. The lack of raifall in 2009 had negative impacts on soybean seed vigour.

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