

SOYBEAN SEED GERMINATION AND INITIAL SEEDLING GROWTH AS AFFECTED BY SEED SIZE ZAVISNOST KLIJAVOSTI SEMENA I POČETNOG PORASTA PONIKA SOJE OD FRAKCIJE SEMENA

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ABSTARCT

Soybean seed size can have a major effect on the quality of seeds. Beside the effect that seed size has on 1000-grain weight, it can also affect other seed quality parameters. Some authors suggest it can be expected that larger seeds have better quality. Seeds with higher content of reserve nutrients provide better developed plants, so it is possible to expect higher yields. Since the soybean seed does not have the minimum dimension of certified seed prescribed by law, it is necessary to examine the minimum size of seed that gives good enough results at planting, growth and development of plants. On the basis of these indicators, set up of cleaners and selection of work sieves cleaners during processing of soybean seed should be accessed. Soybean has a roundish shape, so it is possible to calibrate by a simple procedure using sieves of different sizes and openings. The effect of certain sizes on the soybean seed germination and initial growth of seedlings of varieties which are characterized by different seed sizes was tested in this work. On that occasion the varieties Balkan, Victoria and Trijumf, which were developed at the Institute of Field and Vegetable Crops in Novi Sad were used. Dry matter content in the plant was used as an indicator of initial seedling growth. It was found that the dry matter content of seedlings increases with larger sizes, compared to dry matter content of smaller sizes. Thus, the lowest value was recorded in the variety Trijumf, for the size of 4.0 to 4.5 mm 4.7 g, while the highest value was recorded also in the variety Trijumf for the size of 6.0 to 6.5 mm 8.1 g. In addition, it was observed that the germination of seed of different sizes has different values. The lowest values were recorded in Balkan variety for the size of 4.0 to 4.5 mm 64%, while the highest germination was recorded in the variety Victoria for the size of 5.5 to 6.0 mm 85%.

Keywords: seed, soybean, size, seed germination, seedling.

REZIME

Krupnoća semena soje može da ima veliki uticaj na kvalitet semena. Pored toga što veličina zrna utiče na masu hiljadu zrna, takođe može da utiče i na druge parametere kvaliteta semena. Literaturni izvori navode na zaključak da se može očekivati da je krupnije seme kvalitetnije. Seme sa većim sadržajem rezervnih hranljivih materija daje razvijeniju biljku pa je moguće očekivati i veće prinose. S obzirom da kod semena soje nije zakonom propisana minimalna dimenzija deklarisanog semena, potrebno je ispitati koja minimalna dimenzija semena daje dovoljno dobre rezultate u sevi, porastu i razvoju biljke. Na osnovu tih pokazatelja bi trebalo pristupiti podešavanju prečistača i odabiru radnih sita prečistača tokom dorade semena soje. Seme soje ima okruglast oblik pa je moguće kalibraciju uraditi jednostavnim postupkom pomoću sita različitih dimenzija i otvora. U radu je ispitan uticaj određenih frakcija na klijavost semena soje i početnog porasta ponika za sorte koje se karakterišu različitom krupnoćom zrna. Tom prilikom su korišćene sorte Balkan, Victoria i Trijumf, koje su stvorene u Institutu za ratarstvo i povrtarstvo iz Novog Sada. Kao pokazatelj početnog porasta ponika korišćen je sadržaj suve materije u biljci. Utvrđeno je da se sadržaj suve materije ponika povećava kod krupnijih frakcija u odnosu na sadržaj suve materije kod sitnijih frakcija. Tako je najmanja vrednost zabeležena kod sorte Trijumf za frakciju 4,0-4,5 mm od 4,7 g, dok je najveća vrednost zabeležena takođe kod sorte Trijumf za frakciju 6,0-6,5 mm od 8,1g. Pored toga, uočeno je da klijavost semena različitih frakcija semena ima različite vrednosti. Najniže vrednosti su zabeležene kod sorte Balkan za frakciju 4,0-4,5 mm od 64%, dok je najviša klijavost semena zabeležena kod sorte Victoria za frakciju 5,5-6,0 mm od 85%.

Ključne reči: seme, soja, frakcija, klijavost semena, ponik.

INTRODUCTION

Soybean is characterized by the fact that one plant forms seeds of different sizes. Soybean seed size is a trait depending most on the variety and production conditions. Larger amounts of precipitation and favorable distribution of precipitation during the seed filling, as well as higher temperature sum during this period, contribute to formation of larger soybean seed (Hrustić et al. 2011). If the environmental conditions are unfavorable during the growing season, crop maturity and seed size will be uneven, which can lead to difficulties in harvesting and seed processing. It is important to emphasize that soybean flowers successively, and that on the same plant flower buds, open flowers and pods that are at the stage of seed filling can be found. Previously fertilized flowers or previously formed seeds are able to accumulate a larger amount of assimilates (Kastori 1984). Due to this fact it

can be said that the amount of reserve nutrients of larger seeds is larger and thus supplies the germ with a larger amount of nutrients at the initial stages of growth and development. Additionally, seed size may exhibit a positive effect on seed germination. Many authors noted in their research that the seed size affects germination, while larger seeds have higher germination compared to smaller (Grieve & Francois 1992, Jovičić et al 2010, Štatkić et al 2007), so it is necessary during seed processing to pay special attention to this feature of the seed. Soybean has a roundish shape, so it is possible to do a simple calibration procedure using sieves of different sizes and openings (Babić Ljiljana and Babić M, 2000). Unlike maize seed, small grains and similar crops, the minimum dimensions of certified soybean seeds are not legally defined. Therefore, while processing soybean seed, determining size of sieve openings on cleaners usually depends on the purity of natural seeds (presence of different types of

weed seeds, broken seeds, crop residues, etc.) and seed size (seed filling) of natural seeds. Using correct adjustment of the cleaners and selecting the sieve with appropriate openings, it is possible to eliminate or reduce the content of impurities in seeds, affecting size and 1000-grain weight of processed seed. If seed is being processed on cleaners with bigger openings sieves, processed seed will be bigger with larger 1000-grain weight and vice versa, which can affect the quality of seed. It is therefore important to examine whether seed size can affect the germination and initial seedling growth, which was the aim of this study.

MATERIALS AND METHODS

The research included varieties Balkan, Victoria and Trijumf, created at the Institute of Field and Vegetable Crops in Novi Sad. Seeds were harvested in 2011, which was very unfavorable for the production of soybean. Humidity of harvested seeds ranged from 7.0% to 7.4%. Seeds of these varieties were fractionated on cleaner type "Kamas/Westrup UB600". Five sizes were separated (4.0-4.5 mm, 4.5-5.0 mm, 5.0-5.5 mm, 5.5-6.0 mm and 6.0-6.5 mm) on sieves of rectangular shape. After preparation and formation of the samples, the examination of seed germination started. Seed germination was examined in the laboratory, according to the Regulation on the Quality of Seed of Agricultural Crops (Official Gazette of the SFRY 47/87). Initial seedling growth was studied under field conditions in the area of the experimental field of the Institute of Field and Vegetable Crops, Rimski Sancevi. Sowing was done by hand on 12th of April 2012 with three replications. Initial seedling growth was determined by measuring the dry mass of the aerial parts of seedlings. Randomly selected young plants were sampled from each replication. All plants were cut off with scissors just above the ground and immediately placed in plastic bags. After that, weight of fresh plant material was measured on laboratory scale. Weight of dry above ground parts of the plants was measured after 24 h of drying the plant material in a drier at a temperature of 80°C (Hampton, TeKrony 1995).

RESULTS AND DISCUSSION

Dry mass

The lowest values of dry mass were found in the smallest sizes, and the highest was in the largest sizes. The lowest dry mass was recorded in the variety Trijumf of 4.7 g for the size of 4.0 to 4.5 mm (Fig. 1), while the highest was recorded in the variety Balkan of 8.2 g for the size of 6.0 to 6.5 mm.

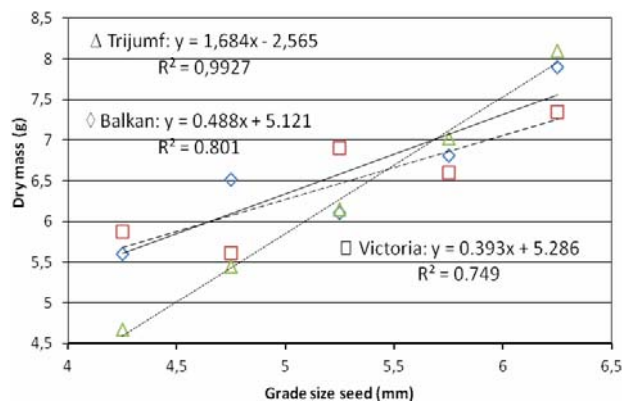


Fig. 1. Values of dry mass of above ground parts of seedlings (g)

In addition, very high dependence between the dry mass and seed size was noticed in all three varieties, especially varieties of Trijumf. Zahra et al. (2011) also found that there is an interac-

tion between the seed size and the weight of seedlings of dry mass. However, in their experiments the weight of seedlings decreased with increasing seed size, which is why they pointed out that large seed, despite having a larger amount of reserve substances has no special advantages over smaller seeds. Zareian et al. (2012) in their studies of wheat seed size effect on dry mass of seedlings found that dry mass of seedlings increased with increasing seed size. They explained higher mass of seedlings with the fact that larger seed has more reserve substances in relation to smaller seed.

Seed germination

Seed germination is the most important parameter of quality. The lowest seed germination was found in the smallest sizes, while the highest germination rates were found in larger sizes (Figure 2).

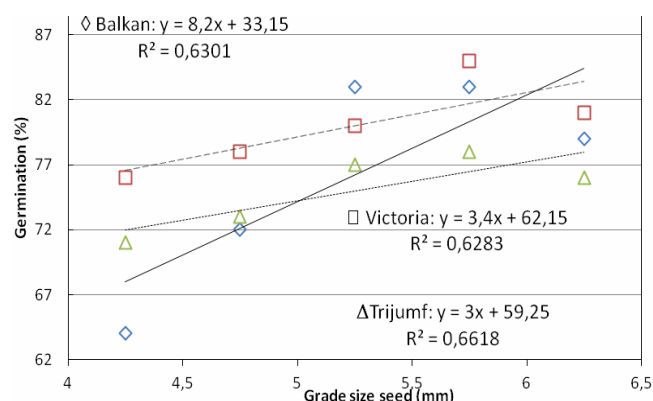


Fig. 2. The values of seed germination by varieties and sizes (%)

The lowest seed germination of 64% was recorded for the size of 4.0 to 4.5 mm in the variety Balkan, and the highest germination of 85% was recorded in the variety Victoria for size of 5.5 to 6.0 mm. Since the permissible minimum germination of certified seeds is 75%, it can be said that the sizes from 4.0 to 4.5 mm and 4.5 to 5.0 mm in the Balkan and Trijumf varieties were not within the statutory minimum. Accordingly, with proper adjustment of cleaners with sieve openings of 5.0 mm it is possible to separate these sizes during seed processing in order to achieve a better quality of processed seeds. Farahani et al. (2011) found that the effect of seed size significantly affected the germination of wheat. Seed germination, dry mass and seedling length increased at the increase of seed size. The aforementioned authors believe that seed with bigger endosperm has a better ability of emergence, where endosperm of large seed increases delivery of stored energy that helps early growth of seedlings. Jovičić et al. (2010) found that the fodder pea variety Dukat had the highest value of 1000-grain weight and the highest value of seed germination, which is explained by the fact that the larger seed contains a significant amount of endosperm and thus provides a seed with sufficient quantity of nutrients in the initial stages of germination.

CONCLUSION

Based on these results, it can be said that seed size affects the initial growth of plants, as well as germination of the seed. The lowest dry matter content was recorded in the smallest sizes and the highest recorded was in the largest sizes, while a linear relationship between dry mass and seed size was high. It can also be said that the smallest sizes achieved lower values of germination compared to the larger. Therefore, in order to improve quality of

seed, cleaners should be adjusted to separate sizes that do not meet statutory minimum of germination from processed seed during processing. Victoria variety achieved better seed germination in relation to the Balkan and Trijumf varieties.

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Received: 29.3.2013.

Accepted: 11.4.2013.