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EFFICIENCY OF ALFALFA SEED PROCESSING WITH DIFFERENT SEED PURITY

EFIKASNOST PRI DORADI SEMENA LUCERKE RAZLIČITE ČISTOĆE

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ABSTRACT

The work was carried out analysis of the impact of the initial purity of raw alfalfa seed on the resulting amount of processed seed in the processing. Alfalfa is very important perennial forage legume which is used for fodder and seed production. Alfalfa seed is possible to achieve high yields and very good financial effects. To obtain the seed material with good characteristics complex machines for cleaning and sorting seeds are used. In the processing center of the Institute for forage crops in Kruševac, alfalfa seed with different initial purity are processed. It is very important that the difference between the amounts of pure seed from laboratory assessment and the actual amount after processing, are low. The six parties of natural seeds of different purity in the range of 74 % to 77.1 % were processed. Also, after each stage of treatment, losses of seeds were measured and seed rate obtained at the end of the processing.

Key words: *efficiency, processing, seed, alfalfa, weeds.*

REZIME

U radu je obavljena analiza uticaja početne čistoće naturalnog semena lucerke na dobijenu količinu dorađenog semena pri procesu dorade. Lucerka je veoma značajna višegodišnja krmna leguminoza koja se osim za krmu koristi i za proizvodnju semena. Gajenjem lucerke za seme, uz odgovarajuću tehnologiju moguće je ostvariti visoke prinose i veoma dobre finansijske efekte jer je seme lucerke kurentna roba na tržištu. U doradnom centru Instituta za krmno bilje u Kruševcu dorađivano je naturalno seme lucerke različitih početnih čistoća. Zadatak dorade je da se seme pripremi za setvu, klijanje i nicanje, kao i čuvanje u skladištima do momenta setve. Proces dorade se izvodi na više mašina za doradu, što podrazumeva različite postupke koji se odvijaju u sukcesivnom nizu što zavisi od ulazne čistoće semena. Pri doradi semena lucerke veoma je važno da razlika između količine čistog semena koja se laboratorijski proceni i stvarne količine dobijenog semena u pogonu za dorado bude što manja. U procesu dorade semena sitnozrnih leguminoza, visina randmana semena direktno zavisi od procenta korovskih vrsta i ostalih primesa u naturalnom semenu. Seme visoke čistoće, sa malim procentom štetnih korova koji otežavaju i poskupljuju proizvodnju, dovodi i do visokog randmana. Pri doradi semena lucerke naturalna čistoća semena zavisi od stanja useva i procesa žetve. Dorađivano je šest partija naturalnog semena različite čistoće u intervalu od 74% do 77,1%. Takođe su, posle svake etape dorade, određivani gubici semena, kao i dobijena količina semena na kraju procesa dorade.

Ključne reči: *efikasnost, dorada, seme, lucerka, korov.*

INTRODUCTION

Alfalfa (*Medicago sativa* L.) is a perennial legume. Thanks to its high nutritional quality, high yield and adaptability, alfalfa is one of the most important legume forages of the world. As a major source of protein for livestock, it is a basic component in rations for horses, dairy cattle, beef cattle, sheep, goats and other species of domestic animals. It is an important source of nectar for bees, too (*Barnes et al., 1988; Burton, 1972; Đukić, 2007*). Worldwide alfalfa as a perennial forage legume covers about 35 million hectares (*Barnes et al., 1988*). Alfalfa (*Medicago sativa* L.) is often called the "Queen of forage crops." It is characterized by extreme flexibility. It is a plant with an efficient source of nitrogen and high production of biomass.

In Serbia (excluding Kosovo, from 2010. to 2013. year), alfalfa was grown on the surface of 187,079 ha (2010) to 176.178 ha (2013), or an average of 181,419.5 ha per year. Average yields of alfalfa dry matter are quite low, from 5,837 kg ha^{-1} (2010) to 4,963 kg ha^{-1} (2013), or an average of 5,030 kg ha^{-1}. In the same period in central Serbia alfalfa is grown on an average of 130,647.5 ha per year, or 72 % of the total area. Average yields were 4,555.25 kg ha^{-1}. In Vojvodina, alfalfa is grown on 50,772 ha per year or 28 % of the total area of Serbia. Average yields of dry matter amounted to 6,281.5 kg ha^{-1} *(Statistical Yearbook of the Republic of Serbia, 2010-2013).*

For the establishment and use of alfalfa crops, the seed must be of high purity, germination, and high genetic value. The majority of these requirements are realized through processing or removal of foreign matter and seeds of lower quality. During alfalfa harvest, the obtained material consists of a mixture of seeds of grown plant and seeds of other crops and weeds, as well as various impurities of organic and inorganic origin *(Đokić et al., 2010; Đokić et al., 2012).* If suitable processing equipment and appropriate processing technology are not used, the result can be the increase of consumption of time and energy for processing and seed losses *(Đokić et al., 2009; Đokić, 2010; Đokić et al., 2010)*.

Seed processing is based on physical characteristics of seed. Prior to every processing, a careful analysis of every set of seeds should be done, which will give the optimal results together with a proper combination of equipment set *(Smith 1988; Copeland and McDonald, 2004; Black et al., 2006, Babić and Babić, 1998, Đokić et al., 2012)*. Each seed lot from the field contains a different set of weed seeds and different amounts of dirty and damaged seed. An operator must know how to adjust the equipment to clean each lot perfectly, while losing a minimum of good seed. The task of seed processing is to remove various

impurities and to extract the natural seeds of pure culture (*Đokić et al., 2008, Savić et al., 2000a*). The right combination of processing equipment is needed to achieve the best quality of processed seed in the shortest possible time, where the quality of seed corresponds to the standards for seed (*Kostić et al., 1990; Savić et al., 2000b*). Processing should satisfy legally recognized seed quality. The conditions and the way of seed production and distribution are determined by the Law on Seed and Planting Material (*Official Gazette of the Republic of Serbia, 2005*), according to the handbook of the International Seed Testing Association (*ISTA, 1999*). Processed alfalfa seed must be of at least 95 % purity value with not more than 2 % seed of other species, 0.5 % of weeds (with no quarantine weeds), 2.5 % of inert matter, germination of 70 % and 13 % of moisture (*Official gazette of the SFRY, no. 47, 1987*). The aim of this study was to determine the extent of the losses on machines alfalfa seed processing depending on the initial seed purity.

MATERIAL AND METHOD

The research was carried out at the processing center of The Institute for Forage Crops in Kruševac. The processing set is standard equipment consisted of following machines and devices: intake pit with belt conveyor, belt conveyors, bucket elevators, fine cleaning machine by a Danish manufacturer Damas-type Alfa 4 and magnetic cleaner by a German manufacturer Emceka Gompper type 4. In the upper shaker shoe machines for fine cleaning of seed Alfa-4 are six screens arranged in two levels (according to the size of perforation), and in the lower shaker shoe is located six screens arranged in two rows. To clean alfalfa seed favorable combination schedule screens on the machine for fine cleaning of seed was established. In the upper shaker shoe were located sieves and sieve with round holes of the following diameters: 2.75 mm; 2.5 mm; 2.25 mm; 2.0 mm; and 1.9 mm. At the bottom of the shaker shoe was in the sieve with longitudinal-cut openings width: 1.3 mm; 1.2 mm; 1.1 mm; 0.6 mm; 0.5 mm and 0.5 mm. Natural alfalfa of six seed lots with different purity was processed by equipment. The quantity of seed was 1300 kg to 1380 kg. At the end of the every processing step, the amount of refined seed was measured, as well as the amount of waste. The waste was measured at six places on the machine for fine cleaning and on three places in a magnetic separator. Measuring the mass of waste and processed seed was performed on electronic scales measuring range up to 300 kg. The analysis of contents of traces in seed samples of 5 g and 50 g was performed in a laboratory by using electronic scales and illuminated magnifying glass. The following parameters were measured: clean seed (%), seed of other species (%), inert matter (%), and weed seed (%), the quantity of processed seed (kg), height of processing output (%) and seed losses on processing equipment (%).

RESULTS AND DISCUSSION

The purity of alfalfa seed of six different seed lots was quite constant (Table 1). The rest consists of inert matter in the form of crop residues (parts of stems, leaves, and pods), sickly damaged grain and seed, soil, also with low variability depending on the tested seed lot. Inert matter in alfalfa seed does not represent a greater problem during the finishing process, unless a greater share unthreshed pods (*Đokić, 2010*). With analysis of samples dodder seed founded at parties I, II, III and VI (two dodder seeds were founded in a sample of 5 g). Seeds of other species were not found in the sample. The average purity of natural alfalfa seeds after first pass of the seeds through the system of processing ranged from 74.0 to 77.1 %. (Table 2). Content of inert matters varied from 22.9 to 26.0 %. After finishing of seed processing, seed purity of all six lots was very high and ranged from 97.0 % (seed lot II) to 98.4 % (seed lot V). Inert matter in the form of empty seeds ranged from 1.6 % to 3 % (Table 3). In all cases, for the inert matters was a significant difference, and for clean seed is not significant. (P<0.05, Tab 1-3). Obtained results varied for the amount of processed seed as well as the waste that is received in the seed processing of all six seed lots. Seed waste is marked according to the place where he was taking (Table 4). At the end of the finishing process on the machine for processing, the amount of waste was measured. On the machine for fine cleaning Alfa-4, at six places seed was collected and the mass of waste was measured. On the magnetic separator waste in three different place was collected (a,b,c). Processing output is calculated by finishing as the losses on the machines for processing expressed as a percentage. On the fine cleaning machine greatest loss is amounted to the lot I (136.9 kg), and the lowest at lot V (90.5 kg) on wind side. At the magnetic cleaner on the (b) place, the greatest loss of 57.7 kg was measured on the lot II. The highest total loss (377.4 kg) was in the lot III and the minimum losses was in the lot V (301.6 kg). The highest seed utilization was in lot V (75 %). The smallest seed losses in seed processing was in lot V (2.3 %). The lowest utilization of seeds was at the party III (69.6 %), with the greatest losses of 6.1 %. Part of the loss of natural seeds (with traces) is lost through the aspirator system.

Table 1. The average purity of natural alfalfa seed

Lot	I	II	III	IV	V	VI	Aver.
Seed structure	%	%	%	%	%	%	
Pure seed	74.0 A	75.6 A	74.1 A	77.1 A	76.7 A	77.0 A	75.8
Other species	-	-	-	-	-	-	-
Inert matter	26.0 A	24.4 AB	25.9 AB	22.9 B	23.3 AB	23.0 B	24.3
Number of weed seed/5g	2 dodder	2 dodder	2 dodder	-	-	2 dodder	-
Total	100	100	100	100	100	100	-

A, B… for row P<0.05, Tukey test

Table 2. Seed purity after first pass through equipment (sample from big seed hopper)

Lot	I	II	III	IV	V	VI	Aver.
Seed structure	%	%	%	%	%	%	-
Pure seed	93.0 A	92.2 A	92.3 A	91.5 A	90.2 A	91.0 A	91.7
Other species	-	-	-	-	-		-
Inert matter	7 B	7.8 AB	7.7 AB	8.5 AB	9.8 A	9.0 AB	8.3
Weed					1 dodder/5g		

A, B… per row P<0.05, Tukey test

Table 3. Seed purity of alfalfa after processing

Lot	I	II	III	IV	V	VI	Aver.
Seed structure	%	%	%	%	%	%	-
Pure seed	98.0 A	97.0 A	97.2 A	98.0 A	98.4 A	97.5 A	97.7
Other species	-	-	-	-	-	-	-
Inert matter	2.0 AB	3.0 A	2.8 A	2.0 AB	1.6 B	2.5 AB	2.3
Weed	-	-	-	-	-	-	-

A, B… per row, P<0.05, Tukey test

Table 4. Amounts of processed seed and waste on seed processing machines

Place of sampling	Lot (kg)						Aver.
	I	II	III	IV	V	VI	
Large pods	13	9.8	13.5	11.6	9.7	17.6	-
Tiny pods	17.2	12.2	18.1	15.1	12.4	22.1	-
Wind I	28.2	22.3	25.0	21.9	19.7	21	-
Wind side	136.9	125.5	143.1	118.4	90.5	93.5	-
Top sieve	30.6	26.5	39.4	33.6	30.5	43.8	-
Lower sieve	74	53.2	63.7	57.2	54.6	56.4	-
Magnetic cleaner (a)	15.5	23.6	16.4	13.9	17.2	38.9	-
Magnetic cleaner (b)	37.1	57.7	38.2	29.7	43.5	28.2	-
Magnetic cleaner (c)	13.9	29.6	20.0	14.8	23.5	19.6	-
∑	366.4	360.4	377.4	316.2	301.6	341.1	-
Natural seed	1380.0	1300.0	1360.0	1360.0	1340.0	1360.0	-
Processed seed	970.0 A	928.4 A	946.0 A	1014.2 A	1004.0 A	1010.5 A	978.9
Processing output (%)	70.3	71.4	69.6	74.5	75.0	74.3	-
Losses **(%)**	5.0	5.4	6.1	3.3	2.3	3.5	-

A, B…per row, P<0.05, Tukey test

CONCLUSION

Examining of natural alfalfa seed in its composition had organic and inorganic impurity. These ingredients were not significantly hindering the process of finishing seeds and these seeds can be easily worked up with appropriate machinery and proper adjustment. Harmful quarantine weeds were not significantly. After each processing stage seed purity was increased. After processing on magnetic separator with the use of metal powder and water, seed with high purity and seed quality was obtained. Seed purity of all six lots was very high and ranged from 97.0 % to 98.4 %. Inert matter in the form of empty seeds ranged from 1.6 % to 3 %. Based on the obtained results with the use of appropriate technological process and applied a system of machines in the processing of alfalfa was determined by total losses on machines for finishing in the process of its production. In order to obtain the highest possible percentage of pure seed must be complied with complete technology in care, protecting and harvesting crops. It is also necessary to adjust properly the machine for processing seeds to decrease seed losses during the finishing process. This technological process of seed can be recommended as standard because seed lots were very similarly in the obtained amount of pure seed at the end of the finishing process.

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REFERENCES

Babić, M., Babić, Ljiljana (1998). Uticaj osnovnih fizičkih osobina semena pšenice na karakteristike strujanja vazduha. Selekcija i semenarstvo, 5 (3-4), 29-32.

Barnes, K., D., Goplen, B., P., Baylor, J., E. (1988). Alfalfa and Alfalfa Improvement. Highlights in the USA and Canada, ch. 1, 1-24. ASA, CSSA, SSSA. Medison, Wisconsin, USA.

Black, M., Bewley, J., Halmer, P. (2006). The Encyclopedia of Seeds Science, technology and uses. Wallingford, UK.

Copeland, L., McDonald B. (2004). Principles of Seed Science and Technology. Kluwer academic publishers, Norwell, Massachusetts, USA.

Burton, J., C., (1972). Alfalfa science and technology. Nodulation and Symbiotic Nitrogen Fixation, ch. 11, 229-246. ASA. Medison, Wisconsin, USA.

Đokić, D., Đević, M., Stanisavljević, R., Terzić, D., Cvetković, Mirjana (2008). Uticaj čistoće naturalnog semena lucerke na randman dorade. Poljoprivredna tehnika. 33 (3), 1-9.

Đokić, D., Đević, M., Stanisavljević, R., Cvetković, Mirjana, Anđelković, B. (2009). Analysis of power cosumption during processing of alfalfa seed of different purity. Journal on Processing and Energy in Agriculture (former PTEP), 13 (3), 261-264.

Đokić, D. (2010). Primena različitih tehničko-tehnoloških sistema u doradi semena lucerke. Doktorska disertacija. Poljoprivredni fakultet, Beograd, Srbija.

Đokić, D., Đević, M., Stanisavljević, R., Štrbanović, R., Jevtić, G. (2010). Effects of different alfalfa seed equipment on processing parameters. XII International Symposium on Forage Crops of Republic of Serbia, Kruševac-Serbia, 26-28 V, Biotechnology in animal husbandry, spec. issue, 26 (2), 253-259.

Đokić, D., Stanisavljević, R., Milenković, Jasmina, Terzić, D., Anđelković, B., Đukanović Lana (2010). The influence of alfalfa seed purity on the electric power consumption during processing. XII International Symposium on Forage Crops of Republic of Serbia, Kruševac-Serbia, 26-28 V, Biotechnology in animal husbandry, spec. issue, 26 (2), 189-195.

Đokić, D., Stanisavljević, R. (2012). Possibility of Improving Seed Processing of Red Clover (*Trifolium pratense* L.) and Alfalfa (*Medicago sativa* L.). Book of the proceedings International Conference on BioScience: Biotechnology and Biodiversity – Step in the Future – The Forth Joint UNS – PSU Conference Novi Sad, Serbia, June 18-20, Institut za ratarstvo i povrtarstvo, Semenarska asocijacija Srbije, 135-148.

Đukić, D., Lugić, Z., Vasiljević, Sanja, Radović, Jasmina, Katić, S., Stojanović, I. (2007). Domaće sorte višegodišnjih leguminoza – nastanak i kvantitativna svojstva. Zbornik radova, Institut za ratarstvo i povrtarstvo, Novi Sad, 44 (1), 7-20.

Glasnik Republike Srbije (2005). 45.

ISTA (1999). International Rules for Seed Testing 1999. Seed Sci & Technol., 27 Supplement, 1 – 333.

Kostić, Ž., Popović, S., Stjepanović, M. (1990). Utjecaj čistoće naturalnog sjemena lucerne na iskorištenje u doradi. Semenarstvo, Zagreb, 7, (90) 4, 199-204.

Radović, Jasmina; Sokolović, D.; Marković, J. (2009). Alfalfa-most important perennial forage legume in animal husbandry. Biotechnology in Animal Husbandry, 25, 465-475.

Savić, Z., Lugić, Z., Neckov, I. (2000a). Uticaj kvaliteta naturalnog semena višegodišnjih krmnih leguminoza na gubitke u doradi semena. I savetovanje, Nauka, praksa i promet u agraru - znanje u hibridu, Vrnjačka banja, 95-98.

Savić, Z., Tomić, Zorica, Lugić, Z., Radović, Jasmina (2000b). Uticaj korovskih vrsta u naturalnom semenu na randman dorade semena lucerke. XI savetovanje, Semenarstvo krmnog bilja na pragu trećeg milenijuma, Sombor, Srbija, 103-110.

Službeni list SFRJ (1987). Pravilnik o ispitivanju kvaliteta semena, Sl. list SFRJ, br. 47/87.

Smith, L., D. (1988). Alfalfa and Alfalfa Improvement. The Seed Industry, ASA, CSSA, SSSA, ch. 33, 1023-1036. Medison, Wisconsin, USA.

Statistical Yearbook of the Republic of Serbia (2010-2013): *http://webrzs.stat.gov.rs/*

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