

LOSSES OF ALFALFA SEED IN THE PROCESSING DEPENDING ON THE INITIAL PURITY OF THE SEED GUBICI SEMENA LUCERKE U PROCESU DORADE U ZAVISNOSTI OD POČETNE ČISTOĆE SEMENA

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ABSTRACT

Alfalfa is the most important perennial forage legume used for seed production and fodder. The seeds of alfalfa for sowing must be of high purity, germination and high genetic value. The initial purity of naturalized alfalfa seed significantly affect the resulting amount of processed seed in processing process. In the processing of natural seed alfalfa seed material to obtain adequate quality by law regulate used a complex machines for cleaning and sorting seeds. In the processing center of the Institute for forage crops in Globoder-Kruševac, Serbia alfalfa natural seed are processed. The six different parties of natural seeds of different purity in the range of 66 % to 85 % were processed. Also, after each stage of treatment, losses of seeds and seed rate obtained at the end of the processing were measured.

Key words: losses, processing, seed, alfalfa, weeds, purity.

REZIME

Lucerka je najznačajnija višegodišnja krmna leguminoza koja se osim za krmu koristi i za proizvodnju semena. Seme lucerke za setvu mora biti visoke čistoće, klijavosti, kao i visoke genetske vrednosti. Početna čistoća naturalnog semena lucerke značajno utiče na dobijenu količinu doradenog semena pri procesu dorade. Takođe utiče i na utrošak energije u procesu dorade, kao i ljudskog rada i količinu otpada. Tokom dorade naturalnog semena lucerke za dobijanje semenskog materijala odgovarajućeg kvaliteta koji je zakonski regulisan koriste se složene mašine za prečišćavanje i sortiranje semena. U doradnom centru Instituta za krmno bilje u Globoderu-Kruševac, Srbija doradivano je naturalno seme lucerke šest različitih partija čistoće od 66% do 85%. Dorada semena ima zadatak da se seme pripremi za setvu, klijanje i nicanje, kao i čuvanje u skladištima do momenta setve. Dorada se izvodi na više složenih mašina koje rade na različitim principima u sukcesivnom nizu što zavisi od ulazne čistoće semena. Veoma je važno da razlika između količine čistog semena koja se laboratorijski proceni i stvarne količine dobijenog semena na kraju procesa dorade bude što manja. Količina dobijenog semena lucerke i ostalih sitnozrnih kultura pri doradi direktno zavisi od udela korovskih vrsta i ostalih primesa u naturalnom semenu. Seme visoke čistoće, sa malim udelom semena štetnih korova koji otežavaju i poskupljuju proizvodnju, dovodi i do visokog randmana. Efikasna dorada semena lucerke se ostvaruje odgovarajućom kombinacijom mašina za doradu pri čemu se dobija odgovarajući kvalitet i veća količina doradenog semena u kraćem vremenskom periodu uz što manji utrošak energije.

Ključne reči: gubici, dorada, seme, lucerka, korov, čistoća.

INTRODUCTION

Alfalfa (*Medicago sativa* L.) is the most important perennial forage legume in the world compared to other legumes. Alfalfa is used for seed production and forage. It is characterized by extreme flexibility, high content of nutrients, especially great protein digestibility and represents the most important and cheapest source of protein in animal nutrition (Radović *et al.*, 2009). In the world, alfalfa as a perennial forage plant is grown on about 35 million hectares (Barnes *et al.*, 1988). It is a plant with an efficient source of nitrogen, high-weight gain of animals, high-nutritional quality and high yield. It is also an important source of nectar for bees (Barnes *et al.*, 1988; Burton, 1972; Đukić, 2007). For the establishment and use of alfalfa crop, seed must be with high purity, germination and genetic value. Most of these requirements are implemented through the seed processing (the removal of impurities and the seeds of lower quality). In the processing of fine grain legumes, seeds output is directly dependent on the percentage of weed species and other particles in naturalized seed. If the appropriate processing equipment and related technology processing are not used, the result can be an increase in the consumption of time and energy for processing and seed loss (Koprivica *et al.*, 2006; Đokić *et al.*, 2009; Đokić *et al.*, 2015). Alfalfa seed is being processed in equipment which uses differences in physical characteristics of seed, such as particle size, shape, density and surface texture. Before each

treatment, it is necessary to carefully analyze each seed lot in order to get optimal results, with the appropriate combination and adjustment of machine (Smith 1988; Copeland and McDonald, 2004; Black *et al.*, 2006; Babić, and Babić, 1998; Đokić *et al.*, 2012). There are several different processes for cleaning and seed processing. Depending on the state and pollution of seeds, the appropriate schedule and appropriate software settings will select. Separation of seeds is based on seven different characteristics of seeds such as: mass, surface condition, width, thickness, length, density, shape, texture and color. The conditions and method of production and distribution of seeds determined by the Law of seeds (Gazette of the Republic of Serbia, 2005), in accordance with the manual International Seed Testing Association (ISTA, 1999). By law, processed alfalfa seed must be at least 95 % purity, up to 2 % of seeds of other species, 0.5 % of weeds (without quarantine weeds), 2.5 % of inert matter, germination rate of 70 % to 13 % moisture (Official Gazette of the SFRY, 47/1987). The aim of this study was to determine how many losses on the machines for processing alfalfa seed depending on the initial purity of seeds, as well as to determine the quantity of processed seed.

MATERIAL AND METHOD

Testing was conducted in processing center of the Institute for forage crops in Globoder-Kruševac, Serbia. The six natural

alfalfa seed lots, with different initial purity, were processed. From each seed lot, three sub-sample repetitions is allocated according to analyze. Equipment for processing consisted of the following equipment Danish manufacturer (Kongskilde and Damas): intake pit with belt conveyor, belt conveyors, bucket elevators, fine cleaning machine tip Alfa-4, and magnetic separator of German manufacturer Emceka Gompper-tip 4.

In the upper shaker shoe machines for fine cleaning seeds Alfa-4, there are six sieves arranged in two levels (according to the size of perforations). In the lower shaker shoe is located six sieves lined up in two rows. Sieves are with performances that showed the best results in alfalfa seed processing. In the upper shaker shoe of the screeners and screens with round holes diameter: 2.75 mm; 2.5 mm; 2.25 mm; 2.0 mm; 2.0 mm and 1.9 mm. The shaker shoe of the lower 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. Measuring the mass of processed seed and waste was carried out on electronic scales measuring range up to 300 kg. Analysis and measurement of samples of alfalfa seed from 5 g to 50 g is carried out in laboratories using electronic scales and magnifying glass lamp. Following parameters were measured: quantity of pure seeds (%), the seed of other species (%), inert matter (%), weed seeds (%), the amount of processed seed (kg), height of processing output (%) and losses on equipment for seed processing (%). To determine the differences between the parties has been applied Tukey's Multiple Range test. Statistical analysis of the results was carried out in the program Minitab 16.1.0 (Statistics software package).

RESULTS AND DISCUSSION

Purity of naturalized alfalfa seed of all six seed lots are shown in Table 1. The purity of tested naturalized alfalfa seed is significantly differed ($p \geq 0.05$; from 66.0 % in the lot V to 85.0 % in the lot IV). The remainder consists of inert matter in the form of crop residues (parts of stems, leaves, pods), briefly and damaged seeds, and the soil; and seed lots also differed significantly (Tab. 1). The minimum content of inert matter was in seed of seed lot IV (15 %). Seed of parties V had the most inert substances; the content of inert matter was 34 %. In seed lot I analysis showed sorghum, pigweed, pods and harvest residues. Of the weed seeds one seed curly dock and two dodder seed in a sample of 5 g were found. In the lot V, with the lowest purity, analysis has found four quarantine weed seeds curly dock and four dodder seeds. Seed lot VI had the highest amount of dodder. In a sample of 5 g, there were 11 dodder seeds and 3 seeds curly dock. In the tested samples of seed other species were not found.

The relationship between pure seeds and impurities in the sample are statistically significantly different in all seed lots except in part II. A statistically significant difference in pure seed was not between the lots I, III and IV, but they differ significantly from the values of other lots (II, V, and VI). Participation of pure seeds in lots I, III and IV was not statistically significantly differences among themselves (83.0 %, 83.0 % and 85.0 %). These values are significantly higher than the content of pure grains in the lots II, V and VI (77.0 %, 66.0 %, 70.0 %), and they had significant differences among this lots. Significantly, most number of foreign matters was found in the lot V (34.0 %) compared to all other parties. Also, impurities in the lot VI were high (30.0 %). Purest seed with a minimum of ingredients were in the seed lots IV (15.0 %), I (17 %) and III (17 %), and there are no differences between them. The content

of impurities from other parties (II, V, and VI) was significantly different. While no statistically significant differences in the content of impurities in I, II and III seed lots. The largest share of impurities was found in the lot V (34.0 %), which is approximately equal to the seed lot VI (30.0 %). Between them there was no statistically significant difference, while in the other seed lots was significantly difference ($p \geq 0.05$).

Table 1. The average purity of natural alfalfa seed

Lot	I	II	III	IV	V	VI
Seed structure	%	%	%	%	%	%
Pure seed	83.0 a	77.0 b	83.0 a	85.0 a	66.0 d	70.0 c
Other species	-	-	-	-	-	-
Inert matter	17.0 bc	23.0 b	17.0 bc	15.0 c	34.0 a	30.0 a
Weed	1 curly dock/5g 2 dodder/5g	-	-	-	4 curly dock/5g 4 dodder /5g	3 curly dock/5g 11 dodder /5g
Total	100	100	100	100	100	100

a, b...different letters indicate statistically significant difference ($p \geq 0.05$; Tukey's Multiple Range test)

The purity of processed alfalfa seed after processing on equipment are showed in Table 2. Seed lot I had an extremely high purity of 98.6 % and 1.4 % of inert matters in the form of empty seeds. Seed purity of lot II was 97.6 % with 2.4 % of inert matter in the form of empty seeds. In the revised seed of lot IV, purity was 97.4 % and inert matter amounted to 2.6 %. In a sample of 5 g three seeds of red clover and a wild peppers were found. Laboratory analysis of the sample of 50 g found two seeds curly dock as not allowed by the Law on seed material.

Table 2. Purity of processed alfalfa seed

Lot	I	II	III	IV	V	VI
Seed structure	%	%	%	%	%	%
Pure seed	98.6 a	97.6 a	98.2 a	97.4 a	96.0 a	98.4 a
Other species	-	-	-	-	-	-
Inert matter	1.4 c	2.4 b	1.8 bc	2.6 b	4.0 a	1.6 c
Weed	-	-	-	3 red clover seed /5 g 1 wild pepper seed /5 g 2 curly dock seed/50 g	5 red clover seed /5 g	2 curly dock seed/50 g
Total	100	100	100	100	100	100

a, b...different letters indicate statistically significant difference ($p \geq 0.05$; Tukey's Multiple Range test)

The lowest purity of natural seeds was in seed lot V with seed purity of 96 %, and 4 % of inert matter.

Due to the high content of inert matter and weed seeds, seed lot V was twice-processed. Laboratory analysis of seed in a sample of 5 g was found five seeds of red clover. In seed lot VI, in a sample of 50 g, 2 seeds curly dock were found. Seed purity was high at 98.4 %, with 1.6 % of inert matters in the form of empty seeds. The relationship between pure seeds and impurities in the sample significantly differed in all seed lots, except in the lot V. Mean values of pure seeds in all parties was about the same, and there were no statistically significant differences. Significantly highest percentage of impurities in the examined samples had a lot V (4.0 %). The content of impurities in the seed lots I (1.4 %), III (1.8 %) and VI (1.6 %) were not significantly different. Between the parties II, III and IV there was no statistically significant differences, too. The percentage share of impurities in the parties II and IV differed significantly from the party I, V and VI, while there was no statistically

significant difference with the party III. The amount of natural alfalfa seeds at the beginning of the processing, as well as the quantity of processed seed was showed in Table 3. The highest percentage of utilization of seed was found in the seed lots IV and III (77.9 % and 77.6 %), which was statistically significant ($p \geq 0.05$) more than in the other lots. Losses of seed were 8.4 %. The lowest percentage of utilization of seeds was at the lot V (53.9 %), with the biggest seed losses of 18.3 %. The seed of this lot was the initial purity of at least 66 % with a significant amount of quarantine weed dodder and curly dock in the analyzed samples. Large losses were also in seed lot VI and amounted to 58.4 %, with total losses of 16.9 %. There were no statistically significant differences between the natural seed, processed seed dressing and processing output, but they significantly differ from the losses. In seed lot II no statistically significant differences between natural and processed seed, but yield losses and processing output significantly differ. There were a statistically significant difference between natural and processed seed and processing losses in the lots III and V. In seed lot IV there was a significant difference between natural and processed seed yield compared to finishing and losses. The same is for the seed lot VI.

Table 3. Amounts of processed seed on processing machines

Seed structure	Lot (kg)					
	I	II	III	IV	V	VI
Natural seed	3294.0 a	2650.0 b	882.0 e	963.0 d	1418.5 c	1407.0 c
Processed seed	2416.0 a	1990.0 b	684.0 d	750.0 d	765.0 d	818.0 c
Processing output (%)	73.3 a	75.1 a	77.6 a	77.9 a	53.9 b	58.4 b
Losses (%)	11.6 b	2.5 d	7.0 c	8.4 c	18.3 a	16.9 a

a, b...different letters indicate statistically significant difference ($p \geq 0.05$; Tukey's Multiple Range test)

So there was the difference between natural and processed seed in respect of yield losses and finishing in the lots II, IV and VI. There was a statistically significant difference in all seed lots in naturalized seed unless the lots V and VI. There was not statistically significantly difference between them. Processed seed in the seed lots I, II and VI significantly differed among them. Statistically significant difference was found in the parties III, IV and V, too. Dressing percentage in lots I, II, III and IV are statistically significantly different from the slate in the lots V and VI. The greatest losses were in the seed lots V and VI and were significantly different from other seed lots. The minimum value of losses was in lot II, which was statistically different from the other parties. Also in lots III and IV there was no statistically significant difference in losses. Equipment for processing seeds of alfalfa during the processing are covered by the system for discharge of deducting cyclones, as well as the same system on the roof of the hall for processing. Part of processed seeds is ejected by air flow in the cyclone. Through the system for dust part of inert matter, dust, broken, small alfalfa seed, and seed of other plant species also were lost. These amounts can't be collected and measured. This amount was count as losses on the equipment.

CONCLUSION

Natural seed of alfalfa had purity of 66.0 % to 85 %. Highest purity of 85 % was in the seed lot IV as well as processing output of 77.9 %. Losses of seeds amounted to 8.4 %. The smallest seed losses of 2.5 % were found in seed lot II. For seed processing with the lowest purity of 66.0% were the biggest seed losses of 18.3 %; with the smallest processing output (53.9 %).

After passing through the machine for fine processing increases the purity of natural alfalfa seeds. Seed on a magnetic separator with the use of metal powder and water in a certain proportion of the seed is obtained in high purity and quality.

Seed purity after processing was very high and significantly higher than the statutory amount (from 96 % for seeds lot V to 98.6 % in seed lot I). Based on the results obtained with the use of appropriate technological procedures and applied the system of machines in the processing of alfalfa were determined total losses on the machines for processing in the process of its production. In order to obtain the highest possible percentage of pure seed it is necessary to properly adjust the machines for seed processing in order to reduce seed losses.

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