EFFECT OF STORAGE TIME ON ALFALFA SEED QUALITY

UTJECAJ VREMENA SKLADIŠTENJA NA KAKVOĆU SJEMENA LUCERNE

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ABSTRACT

Alfalfa (*Medicago sativa* L.) is a crop characterised by presence of hard (dormant) seed that are viable but do not germinate in seed quality testing. In Republic of Croatia seed are frequently stored for three to four years due to low needs for seed of alfalfa and considerable import. The share of hard seed is decreased by storage time, temperature and air moisture changes and therefore directly keeps the level of seed germination in a longer period of storage.

KEY WORDS: alfalfa, germination, hard seed, seed storage

SAŽETAK

Lucerna (Medicago sativa L.) je kultura za koju je karakteristična prisutnost tvrdog (dormantnog) sjemena, koje je živo ali ne klija pri ispitivanju kvalitete sjemena. Zbog malih potreba za sjemenom lucerne i velikog uvoza u Republiku Hrvatsku, nerijetko se događa da sjeme stoji u skladištu tri do četiri godine. Udio tvrdog sjemena sa starenjem, promjenom temperature i vlage zraka se smanjuje, te s tim neposredno utječe na zadržavanje razine klijavih zrna kroz duže vrijeme skladištenja.

KLJUČNE RIJEČI: lucerna, klijavost, tvrdo sjeme, skladištenje

DETAILED ABSTRACT

The commercial alfalfa seed (Medicago sativa L.) is often stored for two or more years. The researches are mainly conducted with the aim of determining the viability of alfalfa seed stored under controlled conditions (constant temperature and air moisture). As commercial seed is most often kept under uncontrolled conditions, the aim of our researches was to determine seed variability after 2, 4 and 8 years of storage. The research was conducted with three recognized Croatian alfalfa cultivars which were harvested and stored in 1994. The years of storage had significant effect on the proportion of germinated, dead and hard seeds. Under uncontrolled conditions the proportion of hard seeds decreased with the storage time and maintained the seed usable for commercial purposes (70%) until the fourth year of storage. The used cultivars showed significant differences in germination and proportion of hard seeds during the storage time, while the proportion of hard seeds had significant cultivar x storage time interaction. OS-90 cultivar had the highest germination after eight years of storage and the lowest proportion of hard seeds. The results indicate that the proportion of hard seeds is a cultivar trait which is not related to the length of seeds' viability.

INTRODUCTION

Lucerna (Medicago sativa L.) is a crop whose seed contains a certain percentage of dormant grain. Many genetic and enviromental factors affect hard seed content in alfalfa. Dormancy of alfalfa seed is most often affected by impermeability of seed coat, inactivity of enzyme system or presence of inhibitors [6.]. Impearmeable coat of alfalfa seed can reduce germination to an extent unacceptable for commercial use [1.]. Alfalfa seed produced in warmer climates often contains less than 20% of hard seed, unlike the seed from colder areas where hard seed content is often up to 50% [4.].

Commercial seed is very often stored in a period of two or more years [2.] before it is used. During the longer storage period hard seed content decreases in the overall seed mass [9.]. Apart from hard seed proportion over storage time, the other germination parameters are also changed: germination energy, germination, abnormal sprouts and dead seed. Many authors have investigated viability of alfalfa seed as well as the factors contributing to maintenance of viability. They point out that increase of dead seed proportion is probably result of protein degradation, damages of chromosome and DNA transformations caused by declining age and external factors [2.,6.,10.]. Proportion of hard seed decreases with the seed aging, temperature changes and air moisture which directly influence the maintenance of germinated seeds' level over longer storage period [8.]. The aim of this research was to determine effect of time (years) storage under uncontrolled conditions on germination parameters as well as the overall germination of alfalfa seed.

MATERIALS AND METHODS

The research was conducted in the labaratory for the seed quality control at the Institute of Agriculture Osijek from 1994 to 2002. Three cultivars were investigated: Vuka, OS-10 and OS-90. The processed seed from 1994 harvest was packed into double-layered paper bags (5kg), closed inside the metal container and kept in a storage facility. The material was stored under uncontrolled conditions at storage air temperature (18 +/-5°C). The germination for all cultivars was determined after 1994 harvest (control) and after 2, 4 and 8 yr of storage. 5 x 100 seeds were randomly selected from the stored seed (from each bag). The seed was sown on blotter paper soaked in water up to saturation. After 10 days of germination at 20°C in the dark, the germinated seeds were counted. Seeds were categorized as germinated, hard (no imbibition or swelling), and nonviable (abnormal, dead, infected or empty seed) in accordance with the 'Book of Regulations for Seed Testing' [5.]. The overall germination of the analysed sample is represented by the sum of hard seed (seed able to germinate after processing) and percentage of normally developed seeds [7.]. The obtained results were subjected to square root transformation due to percentage usage and heterogenous variance and then analysed by using SAS 8 software. The obtained differences were tested by LSD- test.

RESULTS AND DISCUSSION

The results of the research are shown in Table 1. Immediately after the harvest all three cultivars had slightly lower germination (approximately 69,7%). With respect to control, after two years of storage germination was 82,9% which is the highest average germination over years of research. After 4 years of storage the seed germination was significantly lower (72,2%) than after two years, but higher than in control, however without significant differences. The significantly lowest average seed germination over years of storage was obtained after 8 years (41,6%). The obtained differences in the germination over years of storage were significant at level $P< 0,01$. The highest average germination during research period had 0S-90 cultivar (70,4%) which significantly differed at level $P< 0,01$ from Vuka cultivar, but not from OS-10 cultivar. Storage year x cultivar interaction for seed germination trait was not significant.

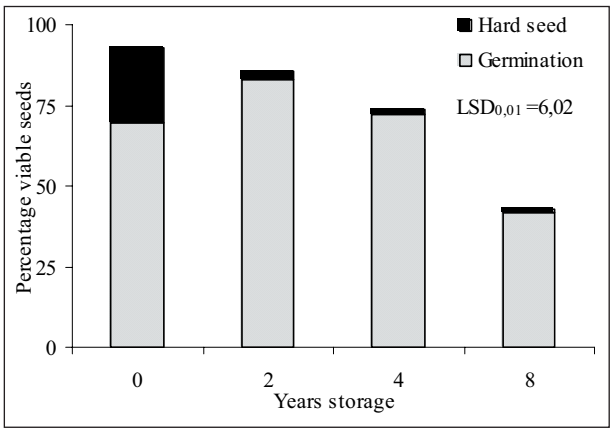
Table 1. Seed quality over the years of storage and cultivars (%)

Cultivar	Germination %					Hard seed %					Dead seed %				
	0	2	4	8	Av.	0	2	4	8	Av.	0	2	4	8	Av.
Vuka	61,3	79,3	72,7	37,0	62,6	33,3	4,0	1,0	0,7	9,8	7,3	16,7	26,3	62,3	28,2
OS-10	69,7	83,7	73,3	40,3	66,7	21,0	3,3	2,0	1,7	7,0	9,3	13,0	24,7	58,0	23,3
OS-90	78,0	85,7	70,7	47,3	70,4	15,7	1,3	1,3	1,3	4,9	6,3	13,0	28,0	51,3	24,7
Average	69,7					23,3					7,7				
	82,9					2,9					14,2				
	72,2					1,4					26,3				
	41,6					1,2					57,2				
	$LSD_{0,01}$ Cultivar				6,3	$LSD_{0,01}$ Cultivar				3,3	$LSD_{0,01}$ Cultivar				n.s
	$LSD_{0,01}$ Year				7,3	$LSD_{0,01}$ Year				3,8	$LSD_{0,01}$ Year				6,3
	$LSD_{0,01}$ CxY				n.s	$LSD_{0,01}$ CxY				6,6	$LSD_{0,01}$ CxY				n.s

Statistically significant differences at level P< 0,01 were determined for hard seed content over years of storage and cultivars and storage year x cultivar interaction trait (Table 1). Hard seed content was significantly the highest (23,3%) after the harvest. During two years of storage, hard seed content decreased significantly to 2,9%, and decreasing tendency continued without significant differences between 2, 4 and 8 year of storage. Vuka cultivar had significantly the highest hard seed content (9,8%) as well as the highest hard seed content in harvest year (33,3%).

Unlike previously analysed traits, neither cultivars nor storage year x cultivar interaction had significant effect on the dead seed content and the obtained differences were significant over storage years (P< 0,01). With storage time from 0 (control) to 8 year the number of dead grains increased and after 8 years of storage the proportion of dead grains was higher than germinated grains' proportion. The dead seed proportion increased linearly from 7,7 to 57,2% with storage time.

Figure 1. Mean viable seed percentage for testing cultivars alfalfa during 8 year storage



The overall germination (viability) is represented by the sum of normally developed seedlings and hard seed. Due to the storage time the overall seed germination decreases (Figure 1). Before the storage, seed viability was 92.3 %, while it decreased during storage time: after the second year (85,8%), fourth year (73,7%) and eighth year (42,8%) with significance P<0,01.

The result of this research indicates that alfalfa seed stored under uncontrolled conditions retains its germination at the level of commercial use from 70% of overall germination [7.] even after four years of storage. The hard seed content decreases rapidly after two years of storage and keeps seed viability at the commercial use level.

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