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THE EFFECT OF A CUTTING SCHEDULE ON THE GERMINATION AND SIZE OF ALFALFA SEEDS

UTICAJ SISTEMA KOSIDBE NA KLIJAVOST I KRUPNOĆU SEMENA LUCERKE

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ABSTRACT

Owing to its characteristics, alfalfa (Medicago sativa L.) is important for the production of high-quality fodder. Its seed yields vary widely and are heavily influenced by environmental factors. The synchronization of alfalfa seed harvest requirements with environmental factors is partially possible through the cutting system. The purpose of this research is to investigate the influence of a cutting schedule on the germination and size of alfalfa seeds. The pre-cutting time did not significantly affect the absolute mass within a 1 pre-cut system, whereas the number of pre-cuts had a reducing impact on the absolute mass within a 2 pre-cut system. The cutting system had no significant effects on seed germination. While the ecological conditions during the year had significant impacts, the lowest seed germination was recorded in the year with the highest rainfall during the summer period.

Key words: *Alfalfa, seed, germination, cutting.*

REZIME

Plava lucerka (Medicago sativa L.) je zbog svih svojih osobina značajna u proizvodnji kvalitetne kabaste hrane. Prinosi semena u Srbiji jako variraju u zavisnosti od godine i kreću se, od onih koji ne opravdavaju troškove žetve, do preko 1000 kg ha^{-1}, dok se u glavnim proizvodnim reonima u svetu beleže stabilniji prinosi. Različitim vremenom kosidbe predotkosa moguće je delimično upravljati vremenom cvetanja semenskog otkosa i na taj način uticati na sinhronizaciju cvetanja i oprašivanja, formiranja mahuna, sazrevanja i žetve sa periodom godine kada postoje najpovoljniji uslovi za to.

Cilj ovih istraživanja je da se u poljskim uslovima ispita uticaj vremena kosidbe na klijavost i krupnoću semena lucerke. Praćeni su uticaji različitih rokova kosidbe prvog predotkosa u proizvodnji semena iz drugog otkosa i uticaj dva predotkosa u proizvodnji semena iz trećeg otkosa.

Vreme predotkosa u sistemu sa jednim predotkosom nije značajno uticalo na apsolutnu masu, dok je u varijanti sa dva predotkosa ostvarena manja apsolutna masa. Posmatrano zajedno u trogodišnjem periodu ostvarena je prosečno masa 1000 semena od 1,92 g, a apsolutna masa se kretala u intervalu od 1,75 g do 2,07 g. Sistem kosidbe nije imao značajan uticaja na klijavost semena. Ekološki uslovi u toku godine imali su značajan utiacaj na klijavost i najmanja klijavost je ostavrena u godini sa najviše padavina u letnjem periodu. Prosečna klijavost je iznosila 82,11%, sa variranjem od 71,50% do 88,40%.

Ključne reči: *lucerka, seme, klijavost, kosidba.*

INTRODUCTION

Owing to its characteristics, alfalfa (Medicago sativa L.) is a perennial legume considered to be important for the production of high-quality fodder. It is greatly significant in crop rotation and represents a model of sustainable intensification. The alfalfa seed is also a valuable commodity on the market.

Its seed yields vary widely and are heavily influenced by environmental factors. The synchronization of alfalfa seed harvest requirements with environmental factors is partially possible through the cutting system. By altering the times of pre-cut harvests, it is possible to influence and direct the phases of seed growth and development making use of different ecological conditions throughout the season, which induce reactions and interactions between plants and environmental conditions (*Strickler, 2000; Cash, 2002; Muller, 2008*). Pre-cut harvests influence the seed growth and development, the beginning and duration of flowering, and the synchronization with the maximum activity of insect pollinators. Moreover, the time of pre-cut harvest can also be used, in part, to avoid the maximum activity of harmful insects and manage the time of flowering, pod formation, maturation and harvest using a period with the most favourable conditions within the year. Timely cuttings can result in higher seed yields (*Strickler, 2000, Vučković et al., 2004, Karagić, 2004, Karagić et al., 2007, Terzić, 2010*).

Globally, there have been a lot of activities aimed at finding the optimal solution for cutting/harvesting in forage and seed production, but there is no a unified opinion related to the optimum time. Most of the studies indicate that specific solutions ought to be sought in each area.

In addition to high yields, the provision of high-quality alfalfa seeds is of paramount umportance. This can be monitored via the germination energy of alfalfa seeds. The absolute mass of the seeds is the component which directly affects the seed yield and quality because it indicates its size and grain filling (*Bolanos-Aguilar et al., 2002; Iannucci et al., 2002*). The purpose of this research is to investigate the effects of cutting and pre-cutting times on the germination and size of alfalfa seeds under field conditions.

MATERIAL AND METHOD

The experimental field of the Institute for Forage Crops in Kruševac was used to conduct the present research. The results obtained over the period of three years (the first in 2005, the

second in 2006, and the third in 2007) are presented in the study. The experiment was conducted in three replications. The plot size was 10.5 m^2. The effects of the following cutting times were monitored and assessed: A_1- early cutting (about May 5th), A_2 medium early cutting (May 15th), A_3- late cutting (around May 25th), A_4- very late cutting (about June 5th), A_5- third cutting (pre-cutting around May 5th and June 5th). In case of the treatments A_1, A_2, A_3, A_4, the second cutting/harvest was a seed harvest, while in the treatment A_5 the third cutting was a seed harvest. Upon completion of the seed harvests and field testing, the 1000 seed mass and germination were investigated under laboratory conditions. The seeds was analysed according to the recommendations of the Rulebook on the Seed Quality Determination (Official Gazette no. 74/87), which is in accordance with the international rules on the seed quality (ISTA 1987).

The statistical processing of the data was done using the analysis of variance (ANOVA). The significance of differences was tested using the LSD test.

RESULTS AND DISCUSSION

The results of the impact of the harvesting system on the mass and germination of alfalfa seeds are presented in Table 1. The absolute mass, depending on the harvesting system and year, ranged from 1.75 g in the treatment A_5 in the first year to 2.07 g in the A_3 system in the third year.

Table 1. The effect of a cutting system on the absolute mass and germination of alfalfa seeds

Year	I	II	III	Aver.	I	II	III	Aver.
Cutting system	Absolute mass (g)				Germination (%)			
A1	1.82aB	1.91aAB	2.04aA	1.92	75.00aB	85.80aA	85.20aA	82.00
A2	1.79aB	1.95aAB	2.05aA	1.93	73.00aB	87.70aA	84.60aA	81.77
A3	1.85aB	1.96aAB	2.07aA	1.96	74.40aB	87.30aA	85.80aA	82.50
A4	1.86aB	1.93aAB	2.00aA	1.93	72.00aB	87.50aA	86.30aA	81.93
A5	1.75aB	1.86aA	1.90bA	1.84	71.50aB	87.10aA	88.40aA	82.33
Average	1.81	1.92	2.01	1.92	73.18	87.08	86.06	82.11
F test	Factor/trait				Absolute mass		Germination	
	Year				x		x	
	Cutting system				x		ns	
	Year x Cutting system				ns		ns	

a, b small letters represent significant effects (LSD test, P≤0.05) for the column
A, B capital letters represent significant effects (LSD test, P≤0.05) for the row

Depending on the cutting system, the largest seeds were formed in the system A_3 (1.96 g). A slightly smaller seed mass was formed in the A_4 and A_2 (1.93 g) and A_1 systems (1.92 g). The minimum of 1000 seeds in all years was recorded in the A_5 system and the average was 1.84 g. The time of pre-cutting did not significantly affect the absolute mass within the 1 pre-cut system, whereas the number of pre-cuts had a reducing impact on the absolute mass within the 2 pre-cut system during all years, and especially in the third year. Similar results are presented by *Erić (1988)* when the average of 1.92 g was achieved in the harvest of the second cutting, and 1.77 g in the third harvest. In the studies by *Karagić (2004),* a lower seed mass was also recorded in the third cutting/harvest (2.15 g) in comparison with the second (2.20-2.26 g). *Terzić* (2010) states that the plants with two pre-cuts have a lower number of shoots, lateral branches, and lower height, which proves that the plants with two pre-cuts are in worse condition resulting in the lower absolute mass of seeds.

Depending on the year, the lowest absolute mass in the first year, on average for all the tested treatments, was 1.81 g. In the second year, the average mass of 1000 seeds amounted to 1.92 g and in the third year it was higher than in the previous two years (2.01 g). Within the three-year period, an average mass of 1000 seeds of 1.92 g was achieved, which is in acoordance with the results of *Erić (1988), Vučković (1994), Beković (2005), and Stanisavljević (2006)***.**

Based on the aforementioned data, it is obvious that a 1000 seed mass depends on weather conditions during the year. In the first year (2005), a total of 808 mm rainfall was recorded, and in June, July and August, a total of 274 mm was observed during 29 days of precipitation. In the second (2006) and third year (2007) in the same period, (June, July and August) significantly lower precipitations occurred (167 and 136 mm) during a lesser number of rainy days (24 and 15). The increased rainfall affected the lodging of seed crop, which affected the absolute weight of seeds. *Terzić et al. (2013)* stated that the absolute mass was negatively correlated with precipitation and with the annual sum (r = -0.45), and that there was a very strong negative correlation with the amount of rainfall in June, July and August (r = -0.97) and the sum in July and August (r = -0.95). The number of days with precipitation in June and July, as well as in June, July and August also showed a strong negative correlation with the absolute mass (r = -0.99 and -0.98).

In all three experimental years, the average germination was 82.11 %, ranging from 71.5 % to 88.4 %. The germination did not always show a clear tendency and the system of cutting had no significant effect on seed germination. When the harvest times are taken into account, the lowest average germination was recorded in the A_2 cutting system (81.77 %). The highest average germination was achieved in the A_3 cutting system (82.50 %), which is in line with the results of *Karagić (2004),* showing the highest seed germination in the late cutting/harvesting system.

The germination significantly differed during the years. The lowest average germination was recorded in the first year (73.18 %), whereas a significantly higher germination was achieved (87.08 % and 86.06 %) in the second and third year. Based on the abovementioned data, it is clearly demonstrated that the germination of 1000 seeds depends on weather conditions during the crop development. The mentioned quality parameters were the worst in the first year when a heavy rainfall was recorded. *Terzić et al. (2013)* stated that seed germination has had a strong negative correlation with the amount of annual rainfall (r = -0.86) and a strong negative correlation with the amount of rainfall in June, July and August (r = -0.95) and the sum of July and August (r = -0.97). In addition, the number of days with precipitation in June and July had a strong negative correlation (r = - 0.77) with seed germination. A large number of days with precipitation and high rainfall during the first year (2005), have affected the lodging of alfalfa, poor nutrition, all of which negatively affected the germination in 2005. Conversely, more favorable conditions during the second and third year (2006 and 2007) induced higher germination (87.25 % and 85.80 %). The results achieved were within the range of

germination results obtained by *Beković (2005); Stanisavljević (2006) and Terzić et al. (2014).*

CONCLUSION

The time of pre-cutting did not significantly affect the absolute mass within the 1 pre-cut system, whereas the number of pre-cuts had a reducing impact on the absolute mass within a 2 pre-cut system. The highest average mass of 1000 seeds was formed in the late cutting system (1.96 g), while the lowest 1000 seed mass (1.84 g) was formed within the 2 pre-cut system during the third harvest.

The system of cutting had no significant effect on seed germination. While the ecological conditions during the year had significant impacts, the lowest seed germination was recorded in the year with the most rainfall during the summer period. The germination was the lowest in the first year (73.2 %), when heavy rainfall was recorded, while the germination was significantly higher (87.1 % and 86.1 %) in the second and third year.

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