Agriculture. Plant growing
BULLETIN OF POLTAVA STATE AGRARIAN ACADEMY
ISSN: 2415-3354 (Print)
2415-3362 (Online)
https://journals.pdaa.edu.ua/visnyk

original article | UDC 633.3:33025:631.164.24:332.66 (292.485) (477) | **doi: 10.31210/visnyk2021.03.05**

INFLUENCE OF SOWING TIME ON PRODUCTIVITY OF SMOOTH BROME GRASS IN THE FOREST-STEPPE OF UKRAINE

L. H. Marinich* ORCID 0000-0002-0073-9433
O. A. Antonets ORCID 0000-0001-6741-9023

Poltava State Agrarian University
1/3, Skovorody str., Poltava, 36003, Ukraine
**Corresponding author*
E-mail: mariniclubov1@gmail.com

How to Cite

Marinich, L. H., & Antonets, O. A. (2021). Influence of sowing time on productivity of smooth brome grass in the ForestSteppe of Ukraine. Bulletin of Poltava State Agrarian Academy, (3), 45–50. doi: 10.31210/visnyk2021.03.05

Perennial grasses are the main fodder crops for hayland and pasture use. Their area of extending is quite large: they are spread from the tropics to the extreme northern regions. Their role is significant in the farming system: they protect the soil from water and wind erosion, enrich it with organic matter, improve the physical and mechanical properties of the soil and precipitation infiltration.The group of forage grasses includes more than 600 species of plants, but smooth brome grass has the greatest forage value has, it is used for green fodder, silage, haylage and grass meal. Under favorable growing conditions, modern zoned varieties of this plant are able to form biological seed yield of up to 0.6–0.8 t/ha, 50.0 t/ha of green mass, and 20.0 t/ha of hay. But obtaining such high and stable yields requires compliance with all agro-technical operations. The purpose of the research was to determine the sowing time, affecting the formation of seed and feed productivity of smooth brome grass. Field and quantitative methods, the method of test sheaf, weight, and statistical methods were used in the proces of research. The high fodder value of smooth brome grass can be explained by the fact that it has a significant number of vegetative shoots with more leaves than on generative ones. In addition, the leaves, especially on vegetative shoots, contain more nutrients. The smallest number of vegetatively elongated shoots was formed by plants of Poltavsky 5 and Poltavsky 52 varieties under the conditions of autumn sowing period. The largest number of vegetatively elongated shoots in these varieties was observed at spring sowing time. The optimal sowing season for obtaining high seed yields for smooth brome grass of Poltavsky 5 and Poltavsky 52 varieties is summer. The optimal sowing time for obtaining high yields of green mass for smooth brome grass of Poltavsky 5 and Poltavsky 52 varieties is spring. Spring sowing time is also the optimal sowing period for obtaining high yields of dry matter for smooth brome grass of Poltavsky 5 and Poltavsky 52 varieties.

Keywords: *smooth brome grass, feed productivity, seed productivity, vegetative shoots, sowing time*

ВПЛИВ СТРОКІВ ПОСІВУ НА ПРОДУКТИВНІСТЬ СТОКОЛОСУ БЕЗОСТОГО В УМОВАХ ЛІСОСТЕПУ УКРАЇНИ

Л. Г. Марініч, О. А. Антонець
Полтавський державний аграрний університет, м. Полтава, Україна

Багаторічні злакові трави є основними кормовими культурами при сінокісному і пасовищному використанні. Зона розповсюдження їх досить велика: вони поширені від тропіків до крайніх північних областей. Значна їх роль і в системі землеробства: вони захищають ґрунт від водної та вітрової ерo-

зії, збагачують його органічними речовинами, поліпшують фізико-механічні властивості грунту та інфільтрацію опадів. У групу кормових злакових трав входить понад 600 видів рослин, але найбільшу кормову цінність має стоколос безостий, який використовують на зелений корм, силос, сінаж та трав'яне борошно. Сучасні районовані сорти цієї рослини за сприятливих умов вирощування здатні формувати біологічну урожайність насіння до 0,6–0,8 т/га, зеленої маси 50,0 т/га, сіна 20,0 т/га. Але отримання таких високих та сталих урожаїв вимагає дотримання всіх агротехнічних операцій. Мета досліджень полягала у визначенні строків посіву, що впливають на формування насіннєвої та кормової продуктивності стоколосу безостого. Під час досліджень використано польовий та кількісний методи, метод пробного снопа, ваговий, статистичний. Високу кормову цінність стоколосу безостого можна пояснити тим, що він має значну кількість вегетативних пагонів, на яких більше листків, ніж на генеративних. До того ж листки особливо на вегетативних пагонах містять більшу кількість поживних речовин. Найменшу кількість вегетативно подовжених пагонів сформували рослини сорту Полтавський 5 та Полтавський 52 за умов осіннього строку сівби. Найбільша кількість вегетативно подовжених пагонів у цих сортів була при використанні весняного строку сівби. Оптимальними строками сівби для отримання високих урожаїв насіння для сортів стоколосу безостого Полтавський 5 та Полтавський 52 є літні. Оптимальними строками сівби для отримання високих урожаїв зеленої маси для сортів стоколосу безостого Полтавський 5 та Полтавський 52 є весняні. Оптимальними строками сівби для отримання високих урожаїв сухої речовини для сортів стоколосу безостого Полтавський 5 та Полтавський 52 є також весняні строки сівби.

Ключові слова: *стоколос безостий, кормова продуктивність, насіннєва продуктивність, вегетативні пагони, строки посіву.*

Introduction

Feed base is the main factor influencing the development of competitive and highly productive animal breeding [15]. Hayfields are in the structure of natural fodder lands of Ukraine. These are farm lands that are systematically used for hay harvesting, pasture and for grazing animals, as well as other land plots suitable for cattle grazing [19, 21]. "For as the earth bringeth forth her bud" [1, Is. 61: 11], so even today fodder grasses are grown. Given the huge potential of Ukraine's meadow lands, which is about 8 million hectares with fallow lands, it is possible to obtain organic fodder products and transfer them from the category of the so-called "abandoned" lands to fodder production, nature protection, recreational and ecological zones. This will make it possible to turn them not only into the elements of good fodder production, but also into environmental elements of agricultural landscapes on the basis of adaptive environmental ecological and recreational land use [12, 13]. Over the years of transformation of the agricultural sector, the area of hayfields in Ukraine has decreased by 1.5 times, and at agricultural enterprises – by almost 11 times. 91 % of fodder products are concentrated on private farms [19].

Perennial grasses are the main forage crops for hayland and pasture use. Their area of extending is quite large: they are spread from the tropics to the extreme northern regions [2, 18]. Their role is significant in the system of agriculture: they protect the soil from water and wind erosion, enrich it with organic materials, improve the physical and mechanical properties of the soil and precipitation infiltration [6, 10, 11].

The group of fodder cereals includes more than 600 species of plants, but smooth brome grass has the greatest feed value; it is used for green fodder, silage, haylage and grass meal [4, 9]. This plant is the best rhizome cereal component on floodplain meadows and can withstand prolonged floods, has high yields and good feed qualities [3]. This plant is rich in protein – it contains up to 15 %, fat – 19.7-24.9 %, fiber – up to 8 %. The main fodder feature of smooth brome grass is that green mass and hay are rich in sugars and mineral elements such as phosphorus, calcium, potassium, sulfur, magnesium, zinc [2].

This cereal is well adapted to different climatic conditions, can be successfully used in grass mixtures of different regions of Ukraine. The tillering node withstands frosts to -46 ° C, and during spring revegetation – up to –18–20° C [8]. In addition – smooth brome grass is one of the most drought-resistant plants among perennial grasses. And the introduction of crops in crop rotation that are able to withstand periodic droughts, is one of the ways to ensure the stability of fodder production [14, 24].

The introduction of new high-yielding varieties of perennial grasses is one of the main reserves for increasing the yield of hayfields and pastures by at least 25–30 % [7, 17].

In modern conditions of developing the agricultural sector of Ukraine, the problem of producing high-quality seed material has become topical. Therefore, it is important to organize cultivation technology

that would guarantee the formation of a high level of green mass, hay and seeds yields [10, 12]. Zoned varieties of smooth brome grass under favorable growing conditions are able to form the biological yield of seeds up to 0.6–0.8 t/ha, green mass – 50.0 t/ha, hay – 20.0 t/ha [22]. The urgency of the problem is to improve the agro-technical methods of growing smooth brome grass to increase its productivity. The *purpose* of the research is to determine the optimal sowing time that affects the formation of seed and fodder productivity of smooth brome grass.

Materials and methods of research

The research was conducted in 2018–2020 on the territory of the experimental field of Poltava State Agricultural Research Station named after M. I. Vavilov of the Institute of Pig-Breeding and Agro-Industrial Production of the National Academy of Agrarian Sciences of Ukraine. The station is located in the central part of the Eastern Forest-Steppe of Ukraine almost on the border with the Northern Steppe and the Southern Forest-Steppe. This is an area of insufficient moisture. The soil is dark gray podzolic. It has the following agrochemical parameters of the arable layer: hydrolytic acidity – 1.9-3.3 mg-equivalent per 100 g of soil; humus content – 2.44-3.46%; pH of the salt extract – 5.8-5.9; motile forms of phosphorus – 13-21 mg per 100 g of soil; easily hydrolyzed nitrogen – 4.42-7.94 mg per 100 g of soil; exchangable potassium - 16-20 mg per 100 g of soil; the amount of absorbed bases – 21-30 mg per 100 g of soil.

According to Poltava meteorological station, the air temperature during the growing season increased by +0.7° C as compared to the average long-term data, while the amount of precipitation decreased by 14.3 mm.

Agricultural techniques for growing perennial grasses are common for the area of the Forest-Steppe.

The experiments were conducted in four cycles with randomized placement of variants with a plot area of 25 m^2. During the studies, the guidelines for field and laboratory experiments with cereals were used. [20, 23, 25]. Accounting for crop structure was performed by analyzing test sheaves. Statistical processing was carried out according to the method of B. Dospekhov [5].

The sowing times were spring (April 10, 2018); summer (August 6, 2018); autumn (September 10, 2018). To determine the feed productivity, sowing was carried out with a row spacing of 15 cm, and seed spacing – 45 cm.

In the experiments, the varieties of smooth brome grass selected at Poltava State Research Station named after M. I. Vavilov of the Institute of Pig-Breeding and Agro-Industrial Production of the National Academy of Agrarian Sciences of Ukraine – Poltavsky 52 and Poltavsky 5 were used.

Research results and their discussion

Smooth brome grass belongs to the group of winter crops. Plants grow quite slowly at the initial stages of development. Shoots formed in late autumn or spring and which have not passed the stage of vernalization, do not pass into the generative stage, and remain in the second or third stage of organogenesis [11]. Based on this, cereal grasses for seeds should be sown in early spring to form more generative shoots by autumn. However, scientific research and the practice of advanced farms have shown that spring cover crops are heavily overgrown with weeds and damaged by pests.

Previously, early spring was the optimal sowing period in the Forest-Steppe zone, when there is enough moisture in the soil. At the accelerated alkalinization, in post-harvest crops, perennial grasses were sown also in the summer. The maximum allowable sowing period was not later than the first decade of September [9].

But, as practice shows, in late summer crops often develop under more favorable weather conditions for the growth of grasses and dense grasslands are formed. However, their yield for following year will still not be high enough, as they do not have time to unravel. And grasses of the winter type of development, if they have not passed the stage of vernalization, will form only vegetative shoots [16].

Now some farms have switched to summer and even autumn crops. The advantages of summer crops are the reduction of weeds, the ability to use freshly harvested seeds for sowing, to conduct a good pre-sowing treatment, which includes several cultivations. And this makes it possible to destroy weeds and create better conditions for plant development. When choosing a summer crop, it should be kept in mind that the seeds germinate in 10–12 days. Due to the fact that the seed has a film on its surface, it needs a significant amount of moisture to germinate.

Autumn crops of smooth brome grass are usually less weedy than spring and have better moisture conditions than summer ones. But if one is late with the crops, there is a risk of weak tillering, which leads to a decrease in winter hardiness and frost resistance. The seed yield of such crops in the first year of use is reduced by 20–25 %.

The results show that the highest yield of smooth brome grass seeds of Poltavsky 5 and Poltavsky 52 varieties was obtained during the summer sowing period on August 20. Summer sowing made it possible to have good seedlings, to form a well-developed grassland. The plants went into winter in a well-developed condition, overwintered well and had the largest number of generative shoots. The seed yield of Poltavsky 5variety in the first year of use was 0.56 t/ha, and in the second year – 0.64 t/ha.

Spring crops of Poltavsky 5 variety were quite weeded, which led to their weakening and reduced yields. In the first year of use it was 0.40 t/ha, and in the second – 0.53 t/ha. The least productive in the experiments was the autumn method of sowing. Plants did not have time to form a sufficient number of vegetatively shortened shoots, which led to a decrease in the number of generative shoots. As a result, the seed yield in the first year of use in the variety was 0.36 t/ha, in the second – 0.50 t/ha (Table 1).

The seed yield of Poltavsky 52 variety during summer sowing in the first year of use was 0.51 t/ha, and in the second year of use – 0.59 t/ha. Spring crops of this variety in the first year had a yield of 0.38 t/ha, in the second – 0.50 t/ha, and autumn crops – 0.39 and 0.47 t/ha, respectively (Table 1).

1. The influence of sowing dates on the seed yield of smooth brome grass

Sowing time	Seed yield, t/ha		
	2018	2019	2020
Poltavsky 5 variety			
Spring (April 10, 2018)	0.40	0.53	0.47
Summer (August 20, 2018)	0.56	0.64	0.60
Autumn (September 20, 2018)	0.36	0.50	0.43
HIP05, t/ha	0.009	0.011	0.010
Poltavsky 52 variety			
Spring (April 10, 2018)	0.38	0.50	0.44
Summer (August 20, 2018)	0.51	0.59	0.55
Autumn (September 20, 2018)	0.39	0.47	0.43
The least significant difference 05, t/ha	0.010	0.014	0.011

The high feed value of smooth brome grass can be explained by the fact that it has a significant number of vegetative shoots with more leaves than generative ones. In addition, the leaves, especially on vegetative shoots, contain more nutrients.

The number of vegetatively elongated shoots in the samples of Poltavsky 5 variety when using spring sowing during the years of study ranged from 36 to 123 pieces/plant. The largest number of them was formed in 2019 and averaged 123 units/plant, in 2018 – 98 units/plant, in 2020 – 112 units/plant. The smallest number of vegetatively elongated shoots was formed by plants of this variety under the conditions of autumn sowing. Their number in 2020 averaged 36 units/plant.

Plants of Poltavsky 52 variety formed the highest number of shoots for the second year of use. Their number was on average 145 pieces/plant. In the first year of use, their number was the lowest – 102 units/plant, and in the third year of use it made 112 units/plant.

The research results show that the highest yield of green mass in Poltavsky 5 variety was obtained during spring sowing. In the first year it made 38.0 t/ha, in the second year – 47.0 t/ha, in the third year – 42.5 t/ha. This sowing provided the formation of a large number of vegetatively elongated shoots, much foliage and tall plants. Summer sowing provided a lower level of green mass yield. In the first year of use the yield of green mass was 34.0 t/ha, in the second year – 44.0 t/ha. Autumn sowing in the first year of use had the lowest yield – 30.0 t/ha, but in the second year of use the yield increased, and the yield of green mass was higher than at summer sowing.

Poltavsky 52 variety had a significantly higher yield of green mass at all sowing dates. In the first year of use, the yield of green mass during spring sowing made 41.0 t/ha, summer – 42.0 t/ha, autumn – 37.0 t/ha. During the second year of use, the highest yield of green mass was obtained at spring sowing – 49.0 t/ha, and the lowest – at summer sowing (Table 2).

The dry matter yield at spring, summer and autumn sowing was higher in Poltavsky 52 variety. At spring sowing the highest yield was obtained in the first year of use 19.0 t/ha, and in the second – 21.0 t/ha. A good crop of dry matter for two years of use provided summer sowing. When used in the first year, 17.0 t/ha were

received, and in the second – 19.0 t/ha. Hay yield at autumn sowing in the first year of use was the lowest, only 14.0 t/ha. But during the second year of use it was not worse than the yield at summer and spring sowings of the same variety.

2. Influence of sowing dates on the yield of green mass of smooth brome grass

Sowing time	Yield of green mass, hundredweight/ha		
	2018	2019	2020
Poltavsky 5 variety			
Spring (April 10, 2018)	38.0	47.0	42.5
Summer (August 20, 2018)	34.0	44.0	39.0
Autumn (September 20, 2018)	30.0	45.0	37.5
HIP05, t/ha	2.42	2.69	2.39
Poltavsky 52 variety			
Spring (April 10, 2018)	41.0	49.0	45.0
Summer (August 20, 2018)	42.0	46.0	44.0
Autumn (September 20, 2018)	37.0	48.0	42.5
The least significant difference 05, t/ha	2.46	2.60	2.51

Conclusions

Determining the optimal time for sowing grasses is crucial in getting a good harvest. The optimal sowing dates for obtaining high seed yields for Poltavsky 5 and Poltavsky 52 smooth brome grass varieties are summer. The optimal sowing dates for obtaining high yields of green mass and dry matter for Poltavsky 5 and Poltavsky 52 varieties are spring.

Prospects for further research. It is planned to conduct research on the peculiarities of agricultural techniques for growing smooth brome grass on Poltavsky 30 and Sokil varieties.

References

1. King James *Version of the Bible*. (n.d.). Religion Past and Present. doi:10.1163/1877-5888_rpp_dum_11577

2. Andreev, N. G., & Saviczkaya, V. A. (1988). *Koster bezostyj*. Moskva: VO Agropromizdat [In Russian].

3. Antonets, O. A. (2006). Konkursne vyprobuvannia sortozrazkiv stokolosu bezostoho. *Visnyk Poltavskoi Derzhavnoi Ahrarnoi Akademii*, 3, 27–31. [In Ukrainian].

4. Buhaiov, V. V., & Marianko, O. S. (2017). Vykhidnyi material dlia selektsii stokolosu bezostoho za umov Tsentralnoho Lisostepu Ukrainy. *Kormy i Kormovyrobnytstvo*, 84, 26–31. Retrieved from: http://nbuv.gov.ua/UJRN/kik_2017_84_6 [In Ukrainian].

5. Dospekhov, B. A. (1985). *Metodika polevogo opyta (s osnovami statisticheskoj obrabotki rezultatov issledovanij)*. Moskva [In Russian].

6. Goloborodko, S. P., & Dymov, O. M. (2019). Global climate change: causes of occurrence and consequences for agricultural production in the Southern Steppe. *Melioratsiia i Vodne Hospodarstvo*, 1, 88–98. doi: 10.31073/mivg201901-162

7. Kobylina, N. O. (2015). Kolektsiini zrazky stokolosu bezostoho ta hriastytsi zbirnoi yak dzherela tsinnykh oznak dlia selektsii na produktyvnist ta adaptyvnist. *Posibnyk Ukrainskoho Khliboroba*, 1, 291–294. [In Ukrainian].

8. Kokhan, A. V., Marinich, L. H., Barylko, M. H., Kalashnik, O. P., Olepir, R. V., & Zakharenko, V. A. (2018*). Selektsiia ta nasinnytstvo odnorichnykh* i bahatorichnykh kormovykh trav: teoretychni ta praktychni aspekty: monohrafiia. Poltava: Astraia [In Ukrainian].

9. Kostenko, S. I., Kosolapov, V. M., Pilipko, S. V., & Kostenko, E. S. (2016). Selekcziya mnogoletnikh zlakovykh trav dlya adaptivnogo kormoproizvodstva. *Kormoproizvodstvo*, 8, 35–38. [In Russian]

10. Kovtun, K. P., Veklenko, Y. A., & Yashchuk, V. A. (1970). Formation of the phytocenosis and productivity of sainfoin-cereal grass mixtures depending on the species sowing methods and spatial arrangement in conditions of the right bank forrest-steppe of Ukraine. *Feeds and Feed Production*, 89, 112–120. doi: 10.31073/kormovyrobnytstvo202089-11

11. Kshnikatkina, A. N., Alenin, P. G., & Alenushkin, K. V. (2014). Priemy povysheniya semennoj produktivnosti kostrecza bezostogo. *Niva Povolzhya*, 3 (32), 26–31. [In Russian].

12. Kshnikatkina, A. N., Alenin, P. G., & Alenushkin, K. V. (2014). Semennaya produktivnost kostrecza bezostogo (BROMOPSIS INERMIS LEYSS) v zavisimosti ot priemov vozdelyvaniya v usloviyakh Lesostepi Srednego Povolzhya. *Niva Povolzhya*, 1 (30), 13–18. [In Russian].

13. Kurhak, V. H., Karbivska, U. M., Panasiuk, S. S., & Havrysh, Ya. V. (2019). Naukovi ta tekhnolohichni osnovy orhanichnoho lukivnytstva. *Visnyk Ahrarnoi Nauky*, 11, 28–33. [In Ukrainian].

14. Marinich, L. H., Barabolia, O. V., & Kavalir, L. V. (2021). Vplyv sortovykh osoblyvostei selektsiinykh zrazkiv stokolosu bezostoho na dovhovichnist i urozhainist travostoiu. *Visnyk Poltavskoi Derzhavnoi Ahrarnoi Akademii*, 1, 90–96. doi:10.31210/visnyk2021.01.10 [In Ukrainian].

15. Moisiienko, V. V. (2011). Naukove obgruntuvannia shliakhiv pidvyshchennia kormovoi produktyvnosti ta dovholittia bahatorichnykh travostoiv. *Visnyk Zhytomyrskoho Natsionalnoho Ahroekolohichnoho Universytetu*, 1 (1), 35–57. [In Ukrainian].

16. Myronova, L. N. (1990). Sozdanye yskhodnoho materyala na osnove yndutsyrovannykh polyploydov y mezhvydovoi hybrydyzatsyy razlychnykh vydov kostretsa. *Candidate's thesis*. Moskva [In Russian].

17. Petrychenko, V. F., Korniichuk, O. V., & Veklenko, Yu. A. (2020). Naukovi osnovy intensyfikatsii vyrobnytstva kormiv na lukakh ta pasovyshchakh Ukrainy. *Kormy i Kormovyrobnytstvo*, 89, 56–72. doi: 10.31073/kormovyrobnytstvo202089-01 [In Ukrainian].

18. Petrychenko, V. F., Korniichuk, O. V., & Veklenko, Yu. A. (2020). Naukovi osnovy rozvytku kormovyrobnytstva v Ukraini. *Proceedings of the XII International Scientific Conference "Feed and Feed Protein."* (2020). doi: 10.31073/kormovyrobnytstvo2020conf [In Ukrainian].

19. Petrychenko, V., Kornijchuk, O., & Zadorozhna, I. (2018). Formation and development of fodder production in Ukraine. *Visnyk Agrarnoi Nauky*, 96 (11), 54–62. doi: 10.31073/agrovisnyk201811-08 [In Ukrainian].

20. Smurihyn, M. A., Novoselov, A. S., Konstantynova, A. K., Rubtsov, M. A., & Fylymonov, M. A. (1985). *Metodycheskye ukazanyia po selektsyy mnoholetnykh trav*. Moskva: VIK [In Russian].

21. Sokolov, Y. D., Merezhko, A. F., Sokolova, T. Y., & Krynychnaia, N. V. (2000). *Mendelevskyi podkhod k opysanyiu nasledovanyia kolychestvennыkh razlychyi*. Luhansk [In Russian].

22. Tarakanov, P. S. (1986). Heterozys v selektsyy ezhy sbornoi. *Selektsyia y Semenovodstvo*, 4, 13–16. [In Russian].

23. Tkachyk, S. O. (Red.). (2015). *Metodyka provedennia ekspertyzy sortiv roslyn hrupy tekhnichnykh ta kormovykh na prydatnist do poshyrennia v Ukraini (PSP)*. Vinnytsia: TOV «NilanLTD» [In Ukrainian].

24. Veklenko, Y. A., Hetman, N. Y., Zakhlebna, T. P., & Ksenchina, O. M. (1970). Productivity of feed crops and efficiency of their growing with organic production of vegetable raw materials. *Feeds and Feed Production*, 89, 143–150. doi: 10.31073/kormovyrobnytstvo202089-14

25. Volkodav, V. V.(Red.). (2001). *Metodyka derzhavnoho sortovyprobuvannia silskohospodarskykh kultur*. Vypusk II. Kyiv [In Ukrainian].

Стаття надійшла до редакції 14.08.2021 р.

Бібліографічний опис для цитування:

Марініч Л. Г., Антонець О. А. Вплив строків посіву на продуктивність стоколосу безостого в умовах Лісостепу України. *Вісник ПДАА*. 2021. № 3. С. 45–50.