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The effect of bubbling on the germination of Sudan grass seeds

In the article the results of experiments to study the effect of bubbling on the germination of Sudan grass seeds before and after cryopreservation were presented. The obtained statistical data were processed using the R-studio program. We calculated the indicators of humidity and germination energy of Sudan grass seeds, and determined the statistically reliable significance between the control and experimental varieties. To conduct the experiment, a bubbler installation was created from a cylindrical container filled with water and a bubbler to supply oxygen. The results of pre-sowing seed treatment were obtained for 4 varieties of Sudan grass: Nika, Tugai, Alina, Novosibirskaya 84. Bubbling increases seed germination compared to the control by 13 % for the Nika variety, by 7 % for the Novosibirskaya 84 variety. While bubbling after cryopreservation significantly reduces the germination of seeds in the Tugai variety by 25 %, in the Alina variety by 32 %, in the Novosibirskaya 84 variety by 33 %, and in the Nika variety by 7 %. Thus, bubbling, in general, had a positive effect on the germination of Sudan grass seeds and may be one of the methods of pre-sowing seed treatment. As a recommendation for improving the germination of Sudan grass seeds, we suggest using bubbling without cryopreservation.

Keywords: bubbling, Sudan grass, germination, germination energy, cryopreservation.

Introduction

An increase in livestock production depends primarily on the feed supply. Its quantitative and qualitative indicators can be improved by correctly selecting highly productive forage crops and improving the technology of their cultivation. In the group of annual forage crops, great importance is given to drought-resistant and highly productive sorghum crops, mainly Sudan grass [1, 2]

Sudan grass is a productive crop capable of producing a consistently high yield of biomass of high feed quality. This agricultural crop is widely used to produce both coarse (hay, haylage) and succulent feed (green mass) [3, 4]. The use of physical methods in plant growing makes it possible to increase the intensity of plant growth and development [5].

To increase the germination of seeds and the density of seedlings, it is advisable to use pre-sowing treatment. Some methods of pre-sowing seed preparation are difficult to implement and require the use of pesticides during the growing season. This is associated with high economic costs for seed preparation, and pesticides have a detrimental effect on the environment and human health [6–9].

Among physical methods, pre-sowing treatment of plants with an electromagnetic field, magnetic field, ultraviolet radiation, ozone, ultrasound, electrochemically activated water and many others has become widespread [10–19].

One of the promising methods of pre-sowing treatment is bubbling seeds with compressed air [16–19].

The purpose of the study was to increase the germination of seeds and the density of seedlings using the physical method — bubbling.

Materials and methods

The object of the study was seeds of Sudanese grass of 4 varieties: Alina, Nika, Tugai, Novosibirskaya 84 (Fig. 1). The seeds were provided by the LLP “Research and Production Center for Grain Farming named after Barayev” (Shortandy village, Akmola region). Laboratory studies were carried out in the laboratory of biotechnology and environmental monitoring of Buketov Univesity.

Pre-sowing treatment was carried out using a bubbler for 24 hours.

After bubbling, before sowing, the seeds were kept in a $KMn0_2$ solution for 10 minutes, then washed with distilled water and sown on damp filter paper in Petri dishes in 4 replicates. The growth dynamics of viable seeds

were recorded daily. On 4 day, germination energy was determined, and on 7 day, seed germination was determined. Next, the viable seeds were counted. The results were entered into the log book.

The obtained static data was processed using the R-studio program. We calculated the humidity and germination energy indicators for 4 varieties before and after cryopreservation.

The experimental scheme was as follows:

1. Control
2. Seeds after cryopreservation without cryoprotectants
3. Bubbling without cryopreservation
4. Bubbling after cryopreservation

Figure 1. Seeds of Sudan grass:
I — Tugai variety; II — Nika variety; III — Novosibirskaya 84 variety; IV — Alina variety

Results and Discussion

Analysis of the data obtained on germination and germination energy of the Tugai variety showed that bubbling after cryopreservation reduces seed germination by 25 % (Fig. 2). In all other variants, seed germination of the Tugai variety, including the control, is 95 %. Bubbling accelerates the germination of seeds, after which the seeds swell and germinate faster, which allows to check the seeds before sowing and have time to sow the seeds at the right time, which is a very important feature of Sudan grass, a crop that is afraid of low temperatures.

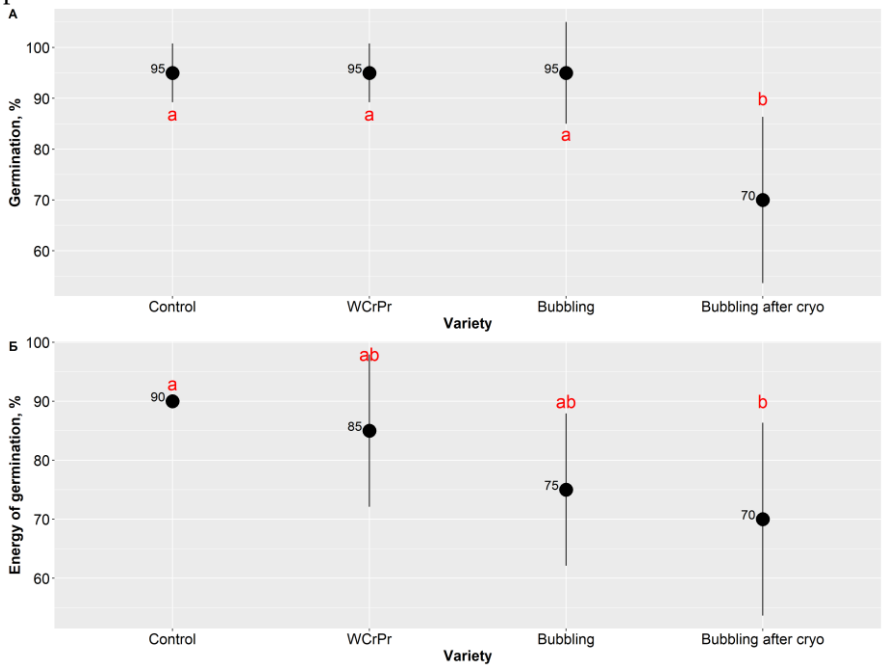

Figure 2. Germination and germination energy of Sudan grass seeds of the Tugai variety

Analysis of the data obtained on germination and germination energy showed that bubbling after cryopreservation reduces seed germination by 25 %. In all other variants, seed germination of the Tugai variety, including the control, is 95 %.

The results of bubbling after cryopreservation are significantly lower than the values in other options.

In terms of germination energy, the maximum values are for the control, the minimum values are for bubbling after cryopreservation. In the variants of cryopreservation without cryoprotectors and bubbling without cryopreservation, the results are statistically insignificantly lower than the control.

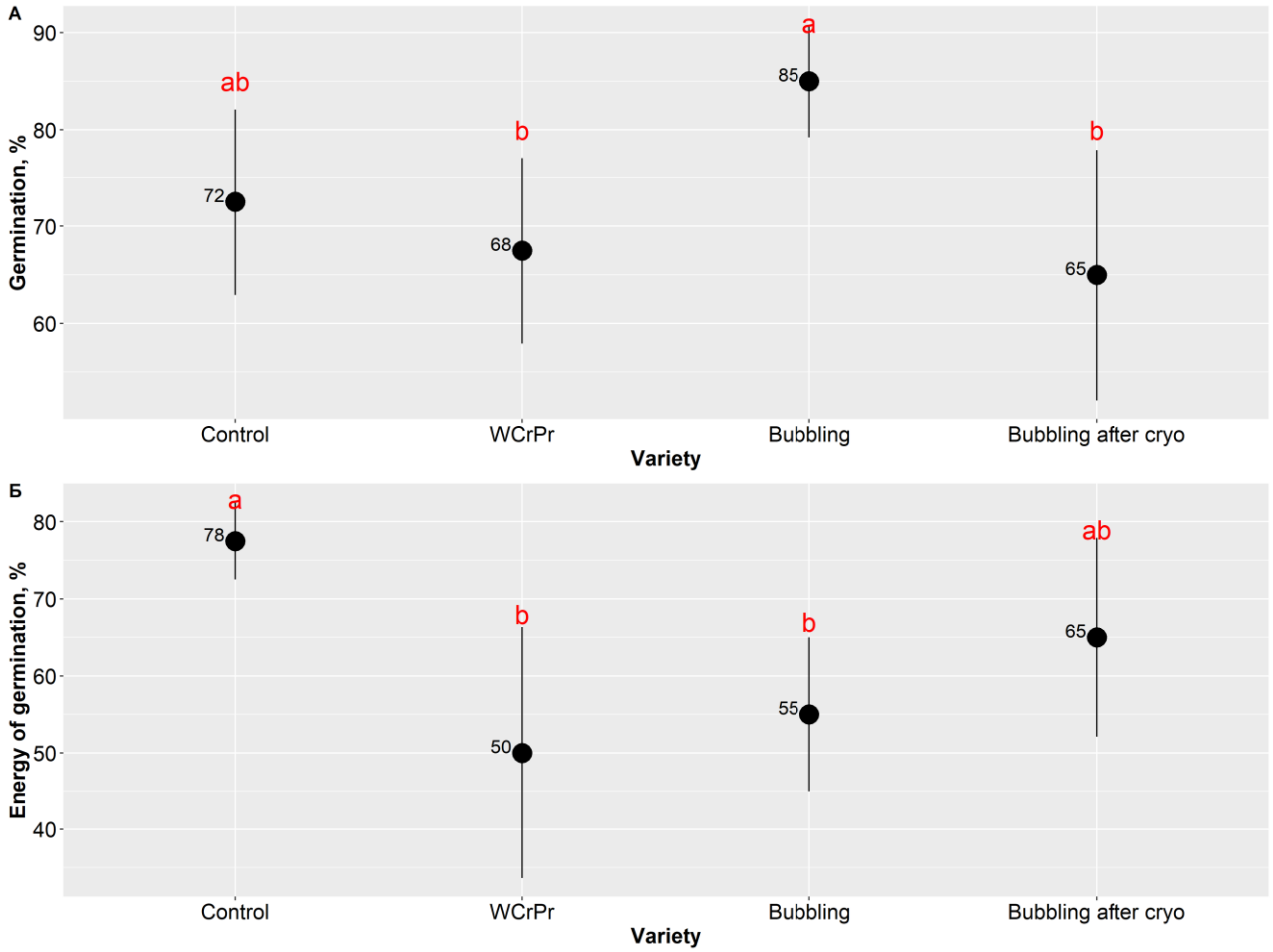

Figure 3. Germination and germination energy of seeds of Sudan grass variety Nika

The Nika variety has a germination rate of 72 % under control. Bubbling increased seed germination by 13 % compared to control. Whereas when bubbling after cryopreservation, germination decreased by 7 %. During cryopreservation without cryoprotectants, a slight decrease in germination was observed (Fig. 3).

Significant statistical differences in comparison with sparging are observed in the variants of cryopreservation without a cryoprotector and sparging after cryopreservation. Compared to control there are only minor static differences.

In terms of germination energy, maximum germination is under control. Reliably significant differences between bubbling and cryopreservation without a cryoprotector. Bubbling after cryopreservation compared with other options shows minor statistical differences.

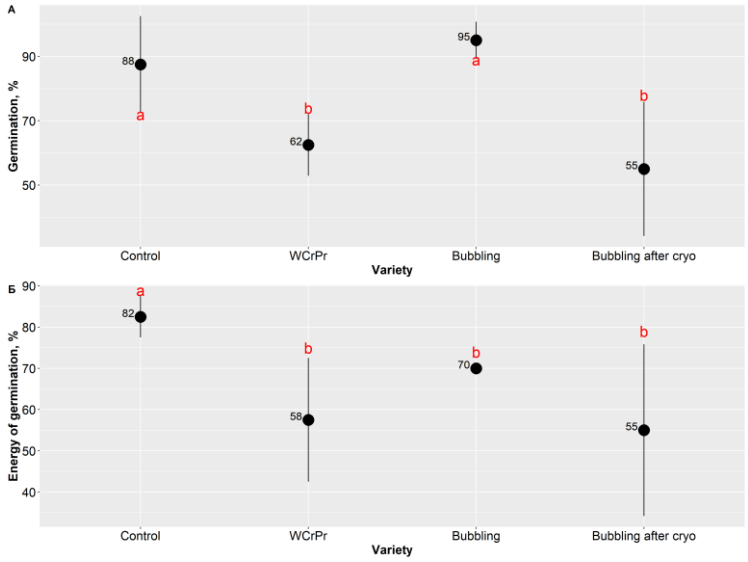

Figure 4. Germination and germination energy of Sudan grass seeds of the Novosibirskaya 84 variety

For the Novosibirskaya 84 variety, germination on the control was 88 %. When bubbling after cryopreservation, seed germination decreased by 33 % compared to the control. When bubbling, germination rate increases by 7 % and amounts to 95 %. Cryopreservation without cryoprotectants reduces germination by 26 % compared to control (Fig. 4).

Thus, statistically significant differences for control and bubbling are the cryopreservation options without cryoprotectants.

When studying the dynamics of germination energy, statistically significant differences are observed between the control and experimental variants.

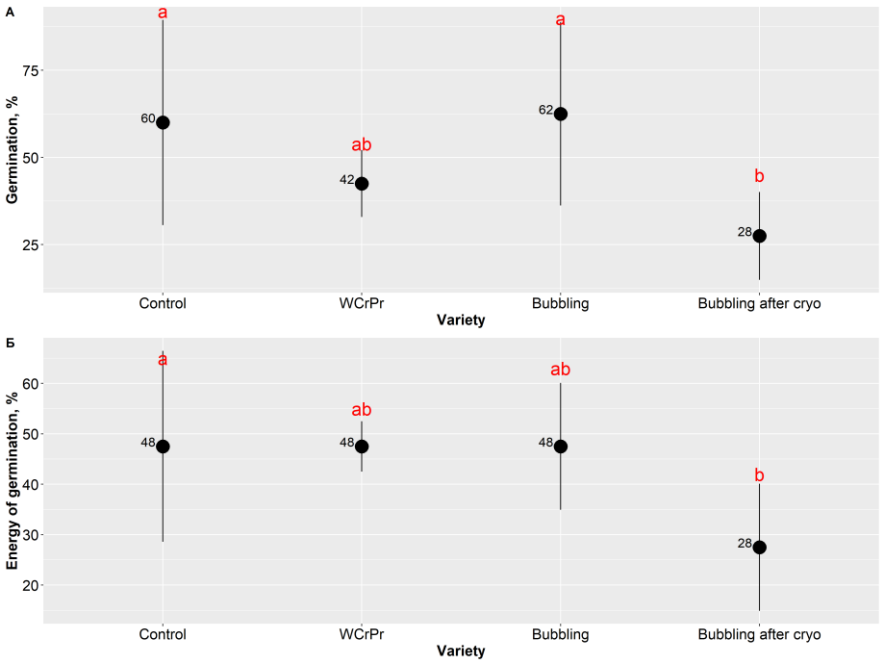

Figure 5. Germination and germination energy of Sudan grass seeds of the Alina variety

The control germination rate of the Alina variety is 60 %. Whereas when bubbling after cryopreservation, germination decreased by 32 %. And during cryopreservation without cryoprotectants, germination decreased by 18 % (Fig. 5).

Statistically significant differences in germination and germination energy between control and bubbling after cryopreservation were noted.

Conclusion

As a result of our research, we determined the effect of pre-sowing treatment using the bubbling method for each variety of Sudan grass.

Bubbling increases seed germination compared to the control by 13 % in the Nika variety, by 7 % in the Novosibirskaya 84 variety.

While bubbling after cryopreservation significantly reduces the germination of seeds in the Tugai variety by 25 %, in the Alina variety by 32 %, in the Novosibirskaya 84 variety by 33 %, and in the Nika variety by 7 %.

Thus, bubbling, in general, had a positive effect on the germination of Sudan grass seeds and may be one of the methods of pre-sowing seed treatment.

As a recommendation for improving the germination of Sudan grass seeds, we suggest using bubbling without cryopreservation.

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А.Н. Мадиева, М.М. Силантьева

Судан шөбі тұқымының өнгіштігіне көпіршіктенудің әсері

Мақалада криоконсервацияға дейін және одан кейін судан шөптерінің тұқымдарының өнуіне көпіршіктердің әсерін зерттеу бойынша эксперименттердің нәтижелері берілген. Алынған статистикалық мәліметтер R-studio бағдарламасының көмегімен өңделді. Судан шөбі тұқымдарының ылғалдылығы мен өну энергиясының көрсеткіштерін есептеп, бақылау және тәжірибелік нұсқалар арасындағы статистикалық маңыздылығы анықталды. Эксперимент жүргізу үшін сумен толтырылған цилиндрлік ыдыстан және оттегімен қамтамасыз ету үшін көпіршікті қондырғы жасалды. Судан шөбінің «Ника», «Тугай», «Алина», «Новосибирская 84» атты 4 сортынан себу алдындағы тұқымдық өңдеудің нәтижесі алынды. Көпіршіктенуде тұқым өнгіштігін бақылаумен салыстырғанда «Ника» сортында 13 %-ға, «Новосибирская 84» сортында 7%-ға артты. Ал криоконсервациядан кейін көпіршіктену «Тугай» сортында 25 %-ға, «Алина» сортында 32 %-ға, «Новосибирская 84» сортында 33 %-ға, «Ника» сортында 7 %-ға, яғни тұқымның өнгіштігі айтарлықтай төмендеді. Осылайша, көпіршіктер негізінен судан шөп тұқымдарының өнуіне оң әсер етті және тұқымды себу алдында өңдеу әдістерінің бірі болуы мүмкін. Судан шөп тұқымдарының өнуін жақсарту бойынша ұсыныс ретінде криоконсервациясыз көпіршікті пайдалануды ұсынамыз.

Кілт сөздер: көпіршік, судан шөбі, өнгіштік, өну энергиясы, криоконсервация.

А.Н. Мадиева, М.М. Силантьева

Влияние барботирования на всхожесть семян суданской травы

В статье представлены результаты экспериментов по изучению влияния барботирования на всхожесть семян суданской травы до и после криоконсервации. Полученные статистические данные были обработаны с помощью программы R-studio. Просчитали показатели влажности и энергии прорастания семян суданской травы, определили статистически достоверную значимость между контролем и экспериментальным вариантами. Для проведения эксперимента была создана барботажная установка из цилиндрической емкости, заполненной водой, и барботера для подачи кислорода. Получены результаты предпосевной обработки семян для 4 сортов суданской травы: «Ника», «Тугай», «Алина», «Новосибирская 84». Барботирование повышает всхожесть семян по сравнению с контролем на 13 % у сорта «Ника», на 7 % — у сорта «Новосибирская 84». В то время как барботирование после криконсервации значительно снижает всхожесть семян у сорта «Тугай» на 25 %, у сорта «Алина» — на 32 %, у сорта «Новосибирская 84» — на 33 %, у сорта «Ника» — на 7 %. Таким образом, барботирование в целом положительно повлияло на всхожесть семян суданской травы и может являться одним из способов предпосевной обработки семян. В качестве рекомендации по улучшению всхожести семян суданской травы предлагаем использовать барботирование без криоконсервации.

Ключевые слова: барботирование, суданская трава, всхожесть, энергия прорастания, криоконсервация.

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