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SWITCHGRASS SEEDS RISING INCREASE

Викладено результати досліджень з ефективності підвищення енергії проростання та схожості насіння проса лозовидного при сортуванні його за питомою масою. Доведено, що за основного сортування при відповідному режимі роботи пневматичного сортувального столу енергія проростання та схожість насіння, яке мало ці показники на рівні 77–78 % підвищувалися на 10 %. Повторне сортування насіння, що надходило в проміжну фракцію та відходи забезпечило отримання підготовленого насіння з енергією проростання і схожістю такою ж, як і за основного сортування – 87 %. При цьому вихід підготовленого насіння зі схожістю 87 % збільшився з 53,9 до 78,6 %. У процесі досліджень встановлено оптимальний режим роботи пневматичного сортувального столу як для основного, так і повторного сортування.

Ключові слова: схожість, режим сортування, просо лозовидне, насіння.

Introduction. Switchgrass (*Panicum virgatum L*.) – is an upright heat-loving plant growing in prairies and looks like a bush cereal [Hivrych O.B. et al., 2011]. Switchgrass can be used as a feedstock for biomass energy production, as ground cover for soil conservation, and to control erosion, for forages and grazing, as game cover, and as feedstock for biodegradable plastics. It can be used by cattle farmers for hay and pasture and as a substitute for wheat straw in many applications, including livestock bedding, straw bale housing, and as a substrate for growing mushrooms. Switchgrass has been researched as a renewable bioenergy crop since the mid-1980 s, because it is a native perennial warm season grass with the ability to produce moderate to high yields on marginal farmlands. It is now being considered for use in several bioenergy conversion processes, including cellulosic ethanol production, biogas, and direct combustion for thermal energy applications. The main agronomic advantages of switchgrass as a bioenergy crop are its stand longevity, drought and flooding tolerance, relatively low herbicide and fertilizer input requirements, ease of management, hardiness in poor soil and climate conditions, and widespread adaptability in temperate climates. In some warm humid southern zones. The energy inputs required to grow switchgrass are favorable when compared with annual seed bearing crops such as corn, soybean, or canola, which can require relatively high energy inputs for field operations, crop drying, and fertilization. Whole plant herbaceous perennial C4 grass feedstocks are desirable biomass energy feedstocks, as they require fewer fossil energy inputs to grow and effectively capture solar energy because of their C4 photosynthetic system and perennial nature. One of the basic advantage of using switchgrass over corn as an ethanol feedstock is its cost of production is average about 1/2 that of grain corn, and more biomass energy per hectare.

Analysis of recent research and publications. The crop has been cultivated in Ukraine for not so long, and therefore it has not been studied properly yet. It is used as a lignocellulosic crop in the US for growing biomass and is aimed to produce bioethanol. There are about 11.3 million h of degraded lands in Ukraine which are not efficient for cultivating crops on. Thus, growing switchgrass to produce solid fuels is topical [Moroz O.V. et al., 2011].

Switchgrass is known to be reproduced by seeds and rhizomes though seeds reproduction is the best. Its seeds are of relatively small size with high dormancy level, especially immediately after harvesting, owing to wild plants adaptation to possible adverse soil and weather conditions. That is

why much of the total seed mass is in a state of organic tranquility, which can last for one, two, three years or longer for each seeds party. In this situation, seed germination could have made only 5%. The tranquility condition can be broken in different ways, but most of them are based on creating stressful conditions during seed germination or prior to it in the pre-sowing treatment by its scarification [ISTA, 1999], soaking seeds or their cooling or pre-warming [2003] as well as treatment with special equipment. Easier, and thus more affordable for producers, ways to improve the seed quality are sorting by their aerodynamic properties and specific gravity which can be possible even in seed farms where the sorting machines are available.

We have found out that sorting switchgrass seeds by their aerodynamic properties is an efficient way. Even at the speed of 5.8 m/sec. in the air aspiration channel the seeds germination increased by 12 %, and the weigh of 1000 pieces – by 3.1 times as compared with the control [Doronin V.A. et al., 2013].

Our study aimed to examine the efficiency of improving the crop seed quality in its sorting by specific weight in two stages. The basic sorting selects seeds with high germination, but the seeds that fell to the medium fraction and wastes were sent to re-sorting (gradual) with the change in pneumatic sorting table mode.

Sorting seeds by their specific weight also revealed positive results. Seeds germination increased from 50 to 79-88 % under that sorting mode, though the germination rate of the seeds sent for re-sorting made 73 %, and for the treated seed it made 57.5-61.5 % [Doronin V.A. et al., 2014]. That is why the aim of our research was to study the efficiency of improving the quality of the crop seed under its sorting by specific weight in two stages. Basic sorting involves removing high germination rate seeds while the ones that get into the medium or wastes fraction and are sent for re-sorting (gradual) with the change in pneumatic sorting table mode.

Materials and methods. The study was conducted at Bioenergetic Crops and Sugar Beet Institute of the Ukrainian National Academy of Agrarian Sciences (BCSBI NAAS) during 2014-2016. Morozko seed variety listed in the Register of plant varieties suitable for cultivation in Ukraine was used in the experiments. The seeds were grown in Yaltushkivka experimental breeding station of Sugar Beet Institute of the Ukrainian National Academy of Agrarian Sciences after the initial clearing. Seeds sorting were performed on laboratory pneumatic sorting table produced by "Vestrub" enterprise by changing the pneumatic table working surface inclination cross angle and oscillation frequency change from 425 to 440 oscillations per minute. The selection of average samples to determine the seed sowing qualities was conducted in accordance with the current standard [ISO 4138-2002]. Seed germination and rising were determined by the method developed by Bioenergetic Crops and Sugar Beet Institute of NAAS [Doronin V.A. et al., 2014]. Statistical analysis of the experimental data was carried out by the methods of variance and correlation analysis described by B.S. Dospyehov [1985] with applying appropriate software.

Results and discussions. The research has found out that the basic (first) quality seed sorting by germination and rising energy of 78 % by their specific weight provided 10 % increase in theses indices as compared to the control (Table. 1).

However, good germination seeds fell to the medium and wastes fraction and these seeds could be separated in the re-sorting. Germination and rising energy of seeds fallen into the medium fraction and wastes were – 84-85 % and 75-76 % respectively. To achieve positive results we changed the mode of pneumatic sorting table in seed re-sorting.

Sorting the seed fallen into the medium and wastes fraction under minor change in sorting tables mode provided obtaining prepared seeds with germination and rising energy of germination of 87 %. This mode of sorting seeds fallen into the medium and wastes fraction care provided not only increased seed germination and rising energy, but obtaining additional amount of prepared seeds as well (Figure 1).

Thus, the output of prepared seeds under basic sorting was 53.9 %, while under second sorting we obtained additional 24.7 % of high-quality seeds from the fallen into medium and wastes fraction out, in addition, which provided increase in prepared seeds output up to 78.6 %.

The research has defined the optimal mode of pneumatic sorting table performance under sorting switchgrass seeds with good quality. The declivity angles in pneumatic table working surface at the first basic sorting should be as follows: 2.0^0 – longitudinal, 0.5^0 – transverse, while at re-sorting they

were as follows: 2.5^0 – longitudinal, 0.5^0 – transverse. Air speed should ensure even coating of the pneumatic table working surface with seeds which affects the quality of sorting by specific gravity. Sorting seeds according to these parameters under the oscillation frequency of the pneumatic table working surface of 440 oscillations per minute provided a significant increase in seed germination and rising as compared to the control (no sorting) in both basic and re-sorting. Re-sorting the seeds which fell into the medium fraction and wastes under this mode of sorting ensured obtaining prepared seeds with the same germination and rising energy of germination as for the main sorting – 87 %. However, the seed that fell in the medium fraction and wastes had, respectively, 70-74 % and 18-50 % of germination and rising.

Table 1 – **Switchgrass seed quality depending on the mode of sorting by specific weight** (average for 2014-2016)

№	Variant – mode of sorting	Seed category	Rising energy, %	Germination, %
1	Basic sorting			
2	Control – without sorting		77,0	78,0
3	Longitudinal angle 2.00, transverse 0.50, frequency oscillations of the working surface of pneumatic table 440 oscillations per minute	Prepared for sowing	87,0	88,0
		Intermediate fraction	84,0	85,0
		Waste	75,0	76,0
4	Seeds sorting that fell to the intermediate fraction and waste after the main sorting			
5	Longitudinal angle $2,5^0$, transverse $0,5^0$, frequency oscillations of the working surface of pneumatic table 440 oscillations per minute	Prepared for sowing	87,0	87,0
		Intermediate fraction	70,0	74,0
		Waste	18,0	50,0
6	$LID_{05\ general}$		1,8	1,8
7	$LID_{05\ basic\ sorting}$		0,5	0,5
8	$LID_{05\ re\text{-}sorting}$		1,3	1,3

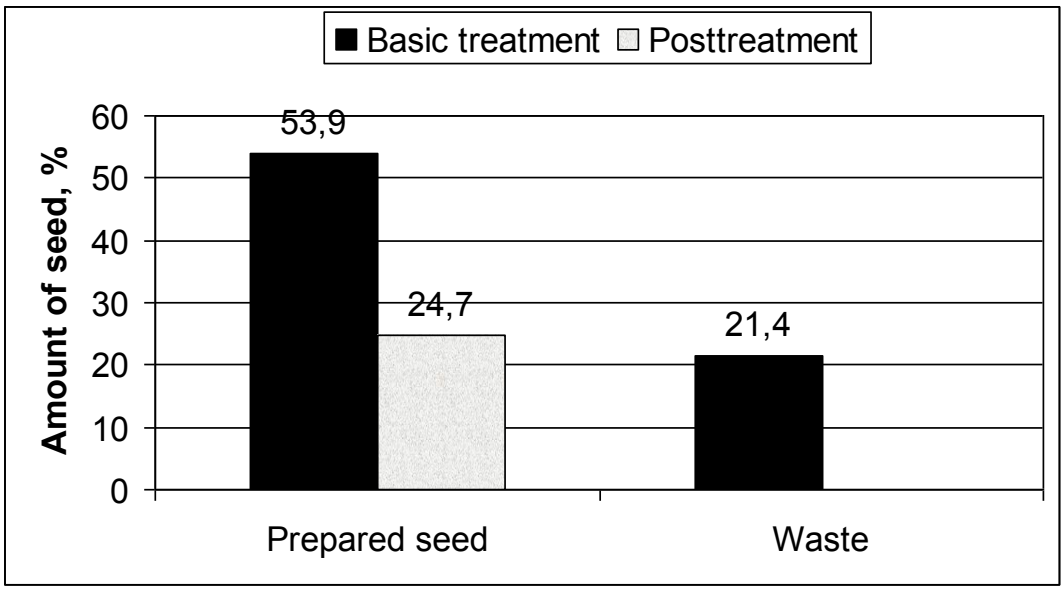

Figure 1. **Seeds output depending on the modes of sorting by specific weight** (average for 2014-2016).

Conclusions. It is advisable to conduct repeated sorting of the seeds fallen to medium fraction and waste while sorting switchgrass seed with germination capacity of 77-78 % by their specific weight. This will provide additional quantities of sowing prepared seeds – up to 25 % with germination capacity of 87-88 %. The optimal mode of the pneumatic sorting table performance in sorting good quality seeds are: pneumatic table working surface declivity angles under the main sorting should be as follows: 2.0^0 – longitudinal, 0.5^0 – transverse; under re-sorting it should be 2.5^0

– longitudinal, 0.5^0 – transverse, the working surface frequency fluctuations – 440 oscillations per minute. Air speed should range within the limits ensuring seeds uniform coating of the pneumatic table working surface.

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Повышение всхожести семян проса лозовидного

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Изложены результаты исследований по эффективности повышения энергии прорастания и всхожести семян проса лозовидного при сортировании его по удельной массе. Доказано, что при основном сортировании, при соответствующем режиме работы пневматического сортировочного стола, энергия прорастания и всхожесть семян, которые имели эти показатели на уровне 77-78 % повышались на 10 %. Повторная сортировка семян, что поступало в промежуточную фракцию и отходы, обеспечивало получение подготовленных семян с энергией прорастания и всхожестью такой же, как и в основной сортировке – 87 %. При этом выход подготовленных семян со всхожестью 87 % увеличился с 53,9 до 78,6 %. В процессе исследований установлен оптимальный режим работы пневматического сортировочного стола как для основной, так и повторной сортировки.

Ключевые слова: всхожесть, режим сортировки, просо лозовидное, семена.

Switchgrass seeds rising increase

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The article presents the results of research on improving the efficiency of switchgrass seed germination and rising in its sorting by specific weight. It has been proved that in the main sorting, under appropriate pneumatic sorting tables mode, seed germination and rising rates which made 77-78 % increased by 10 %. Re-sorting the seeds, which fell to the medium fraction and waste ensured obtaining prepared seed with germination and rising energy equal to that of the main sorting – 87 %. Prepared seed yield with 87 % rising increased from 53.9 to 78.6 %. Optimal operation of pneumatic sorting tables for both basic and re-sorting has been found out during the studies.

Key words: germination, mode of sorting, switchgrass, seed.

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