Sowing qualities and yield properties of Sudanese grass depending on fractionation

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Abstract. Research have been conducted on the development of recommendations for the obtaining and preparation of seeds of Sudanese grass for sowing, because in modern conditions increased demands are made on the quality of the sowing material. In the problem of realizing the genetic potential of a variety, an important role is given to the quality of the seed material. Therefore, all agrotechnical measures should be aimed at preserving and increasing the viability of seeds during their origin, growth, development and storage, that is, a special technology for growing seed should be developed and applied. Only with high seed quality the potential of the variety can be realized. The dependence of the yield of green mass of Sudan grass on the fraction of seeds and the seeding rate was revealed. In years with different weather conditions, seeds with the highest specific gravity had the best germination ability. On these options, the highest yield of fodder mass of Sudanese grass was noted. It was found that using the CAD separator, it is possible to select biologically valuable seeds of Sudanese grass, formed in the middle part of the panicle, remove lightweight impurity, improve the quality of seed and significantly increase the yield of green mass by 13%.

1. Introduction

Feed production is the largest and most complex sector of the rural economy.

An important condition for increasing the efficiency of production and reducing their cost is full feeding, providing farm animals with complete multicomponent feed mixtures [1]. Traditional forage crops (a mixture of corn, peas and oats) are insufficient for the needs of animal husbandry in a balanced inexpensive feed [2].

The most important element in creating a sustainable forage base is the cultivation of drought-resistant sorghum crops. The most promising of them is considered Sudanese grass - Sorghum sudanense (R) Stapf. In arid weather conditions, it provides a stable yield compared to traditional fodder crops. It can grow quickly after mowing and grazing [3,4].

Sudan grass is a valuable crop to produce green fodder, hay and silage. Green mass, both in pasture and in mowed form, is well eaten by all types of livestock. 100 kg of silage contains 23 feed units and 1.8 kg of digestible protein, which exceeds the content of feed units and digestible protein in other annual cereal grasses [5]. It contains a significant amount of easily digestible nutrients; therefore, it is widely used in the green conveyor. Sudan grass is an unpretentious crop with high drought and heat tolerance, which in any conditions can form 2-3 green mass mowing [6,7]. Due to this, it can be used for green fodder from the middle of summer and up to autumn frosts, when other forage crops deplete...
green mass reserves [8]. Sorghum roots secrete a powerful bioherbicide known as sorgholeon, which is produced in living root hairs and has phytotoxicity for broad-leaved and grassy weeds [9].

However, despite these advantages, Sudan grass sowing areas are insignificant [10, 11]. The main reason is the lack of zonal technologies for its cultivation for seeds, and high-quality preparation of seed material for sowing.

In this regard, the topic of this study, devoted to the study of the yield and sowing qualities of seeds of the Sudan grass variety Voronezhskaya 24, is relevant.

The purpose of the research is to assess the yield and sowing qualities of seeds of the Sudan grass variety Voronezh 24 depending on their size and density.

Research objectives:
1. To assess fractions by weight of 1000 pieces of seeds.
2. To assess the effect of seed size and density on their sowing qualities

2. Material and Methods
The research was conducted in 2016-2018. at the department of selection and seed production of Voronezh State Agrarian University. The precursor is soy. Common agricultural technology for the zone. The plot area is 50 m\(^2\). Four repetition. The method of allocation of plots is systematic.

The object of research is the seed fraction of the Sudan grass variety Voronezhskaya 24.

Sorting of seeds was carried out:

| Scheme of experiment: |
|-----------------------|
| 1. C - control (unsorted seeds); |
| 2. ADS 2 - the second fraction of seeds obtained using an aerodynamic separator; |
| 3. ADS 3 - the third fraction of seeds obtained using an aerodynamic separator; |
| 4. MS 1 - the first fraction of seeds obtained using a meshless separator; |
| 5. MS 2 - the second fraction of seeds obtained using a meshless separator; |
| 6. MS 3 - the third seed fraction obtained using a meshless separator. |

3. Results and Discussion
Using a sieve-free separator, three seed fractions were obtained, weight 1000 pcs. which varied from 10.9 to 16.2 g. Moreover, large seeds (fraction MS 3) accounted for more than 50% of the total seed heap. Since small seeds accounted for only 5% of the total mass, we did not use them for further studies (Table 1).

| Table 1. Weight 1000 pcs. seed |
|-------------------------------|
| Option | Weight 1000 pcs., g | % of the total mass |
|-------|----------------------|---------------------|
| C     | 14,8                 | -                   |
| MS 1  | 10,9                 | 5,0                 |
| MS 2  | 13,3                 | 37,3                |
| MS 3  | 16,2                 | 55,0                |
| ADS 2 | 15,9                 | 36,5                |
| ADS 3 | 14,1                 | 41,0                |

Fractions, the separation of which was carried out by seed density, by weight of 1000 pcs. seeds practically did not differ.

Sorting proved effective only in relation to germination (table 2).
Table 2. The effect of sorting on the sowing quality of seeds (according to analysis of variance)*

| Factor     | SS     | Degr. of Freedom | MS     | F      | p      |
|------------|--------|------------------|--------|--------|--------|
|            |        | Germination energy |        |        |        |
| Intercept  | 96170,8| 1                | 96170,8| 1341,0 | 0,00   |
| Fraction   | 534,3  | 5                | 106,9  | 1,490  | 0,30   |
| Error      | 502,0  | 7                | 71,7   |        |        |
| Intercept  | 110155,9| 1              | 110155,9| 24350,3| 0,00   |
| Fraction   | 132,3  | 5                | 26,5   | 5,9    | 0,02   |
| Error      | 31,7   | 7                | 4,5    |        |        |

Note. A significance level p of less than 0.05 indicates a reliable effect of the studied factor.

The purpose of sorting is to obtain seed fractions with different sowing and yield properties. By separating the seeds of Sudanese grass by size, it was possible to isolate seeds with low germination (fraction MS 2). The fractions obtained using the ADS, practically did not differ from each other. The lowest germination energy was observed in the seeds of the control variant (Figure 1).

During the growing season, an assessment was made of the growth dynamics of plants of the Sudanese grass. All measurements were carried out in the field on plants marked with labels. Due to this, the plants are stored until harvest, after which it is possible to analyze their productivity.

As a result of the studies, it was found that the height of the plants and its growth depended on the size of the seeds (Table 3).

The plants of the ADS 2 fraction were characterized as the highest, that is, these are heavy seeds. Plants of seed fractions, separated by size, practically did not differ by this characteristic. The plants of the control variant were characterized by the lowest indicators (Figure 2).
Table 3. Assessment of the significance of the effect of seed size on the height of Sudan grass plants (according to analysis of variance) *

| Factor       | SS       | Degr. Of Freedom | MS       | F       | p     |
|--------------|----------|------------------|----------|---------|-------|
| Plant height (July 7) |          |                  |          |         |       |
| Intercept    | 282270.0 | 1                | 282270.0 | 4559.3  | 0.00  |
| Fraction     | 4482.1   | 4                | 1120.5   | 18.1    | 0.00  |
| Error        | 5262.4   | 85               | 61.9     |         |       |
| Plant height (July 14) |        |                  |          |         |       |
| Intercept    | 945951.9 | 1                | 945951.9 | 4162.4  | 0.00  |
| Fraction     | 16765.8  | 4                | 4191.5   | 18.4    | 0.00  |
| Error        | 18635.4  | 82               | 227.3    |         |       |
| Growth rate  |          |                  |          |         |       |
| Intercept    | 789857.8 | 1                | 789857.8 | 7989.3  | 0.00  |
| Fraction     | 30952.3  | 41               | 754.9    | 7.6     | 0.00  |
| Error        | 4448.9   | 45               | 98.9     |         |       |

Note. A significance level p of less than 0.05 indicates a reliable effect of the studied factor.

Figure 2. Plant height of Sudanese grass

By the time of ripening, the plants of the MS2 MS 3 and ADS 2 fractions practically did not differ in height. The control plants were lower by more than 10 cm and were characterized by low leafiness (Table 4). The height of plants in the ADS3 fraction was only 147.7. However, plants of this variant were characterized by the highest foliage of the shoot (4.6 pcs.).

Significant differences were noted in plants of the obtained fractions along the panicle length. At the same time, plants grown from seeds of higher density (ADS 2) and smaller size (MS 2) were characterized by a shorter panicle (Table 5).
Table 4. Biometric indicators of plants of Sudanese grass of different fractions of seeds

| Option | Plant height, cm | Shoots | Leaves | Leaves on the shoot | Shoot diameter, cm |
|--------|------------------|--------|--------|---------------------|-------------------|
| C      | 140.8            | 2.0    | 6.6    | 3.3                 | 0.54              |
| MS2    | 152.3            | 2.0    | 7.6    | 3.8                 | 0.52              |
| MS3    | 152.1            | 2.0    | 7.4    | 3.7                 | 0.52              |
| ADS 2  | 153.9            | 2.5    | 7.7    | 3.1                 | 0.55              |
| ADS 3  | 147.7            | 1.7    | 7.9    | 4.6                 | 0.55              |

Table 5. Productivity and its elements of plants of the Sudanese grass varieties Voronezhskaya24

| Option | Panicle length, cm | Mass of seeds, g | The number of grains in a panicle, pcs. |
|--------|--------------------|------------------|---------------------------------------|
|        |                    | panicles 1000 pcs |                                        |
| C      | 30.7               | 7.5              | 11.9                                  | 630                |
| MS 2   | 24.4               | 7.0              | 11.8                                  | 593                |
| MS 3   | 32.2               | 8.0              | 12.4                                  | 645                |
| ADS 2  | 28.0               | 5.1              | 14.0                                  | 364                |
| ADS 3  | 32.5               | 5.4              | 14.6                                  | 370                |

The plants with the control variant (7.5 g) and CB 3 (8 g) were characterized by the highest productivity. In plants of both fractions obtained by specific gravity sorting, the lowest productivity was noted due to the low graveliness of the panicle, however, the mass is 1000 pcs. seed was the highest (14 g). It should be noted that differences in productivity and all its elements were noted only in plants of fractions obtained by sorting by size, which indicates the effectiveness of this technique. The plants of the ADS fractions practically did not differ from each other.

4. Conclusion

In the course of the research it was found:

1. The highest sowing qualities were of medium-sized seeds (3 fractions).
2. The duration of the growing season, the yield of green mass, the biometric indicators of plants of the Sudanese grass depended on the size of the seeds.

It has been established that when growing Sudan grass for green fodder, it is necessary to use seeds with a high specific gravity, since the plants obtained from them are characterized by a more powerful development of vegetative organs.

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