The Population Of Festuca Arundinaceae Sherb. The Cretaceous South Of The Middle Russian Uplands As A Starting Material For The Selection Of Grass Bearing Varieties

THE POPULATION OF FESTUCA ARUNDINACEAE SHERB. THE CRETACEOUS SOUTH OF THE MIDDLE RUSSIAN UPLANDS AS A STARTING MATERIAL FOR THE SELECTION OF GRASS BEARING VARIETIES

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Abstract. Collected specimens of Festuca arundinaceae Sherb. (2014-2018). Source material for breeding was obtained as a result of expeditionary studies in the Belgorod region in different ecotopes of ravine and ravine complexes, floodplains of rivers, and technogenic-disturbed lands. Tests of breeding value of selected forms were carried out in comparison with released varieties of Russian ('Olshanka', 'Ivitsa', 'Darina') and foreign breeding ('Finelawn', 'Meandre'). It has been established that the forms selected in natural habitats had wide limits of variation in all basic selection traits - Cv varied from 11.4% for traits 'number of shoots on 1 plant' and 'number of productive shoots on 1 plant' to 65.4% for the trait 'color of knots'. Wild populations provide opportunities for selection of such important for selection on seed productivity traits as "number of seeds in one panicle" and "weight of 1000 seeds" - Cv = 12.1 % and 16.1 % accordingly. The results indicate the possibility of using the source material available in the collection to produce new lawn varieties with high seed productivity and ornamental value.
Keywords: genetic resources, seed productivity, aboveground productivity, morphological traits.

1. Introduction

The southern slopes of the Srednerusskaya Upland, especially within the Belgorod region, are a very interesting region in botanical terms. The territory is located on the section of the steppe and forest-steppe zone, which determines the diversity of climatic conditions. The high ruggedness of the territory with a wide distribution of ovary and beam complexes makes the mesorelief and microrelief diverse, which contributes to the formation of a great variety of plant habitats [1-4].

Reed fescue *Festuca arundinaceae* Sherb. - is a globally widespread species with a large number of breeding varieties. These varieties have both forage and lawn purposes. Moreover, breeding forms for forage and lawn use are sharply different. If forage varieties are characterized by the selection of forms with high fodder productivity, soft leaves due to a decrease in their silicon content and in the number of trichomes, for lawn grasses, low grassiness, formation of a large number of thin leaves, color range,

ability to form decorative, mowing-resistant herbage become important. All these qualities need to be formed by breeders on the background of high seed productivity [5-11].

The wide distribution of chalky substrate, which has physiological dryness and high albedo, contributes to the formation of stable populations of plants of a special phenotype in the south of the Central Russian Upland [12-16].

Among cereal grasses, xerophilous, ecotypes with small, narrow leaves covered with a waxy patina are widespread. This feature of chalky substrate as a selective factor suggests that in the conditions of the south of the Central Russian Upland, populations of valuable forms of F. *arundinaceae* suitable for creating valuable lawn varieties with a number of important features: drought tolerance, short stature, fine-leaved, high seed productivity, etc., can be formed. [17].

The purpose of our study was to assess the bioresource potential of local populations of F. *arundinaceae* formed in different ecotopes with a predominance of carbonate substrate and its evaluation to create lawn varieties with high ornamental and economic traits.

2. Methods and materials

The theory of formation of a secondary anthropogenic microgenetic center of cultivated plants in the Cretaceous south of the Central Russian Upland, previously developed by us, served as the methodological basis for the studies [2, 14-16].

The collection samples were studied at the experimental field of CJSC Krasnoyaruzhskaya Grain Company in 2014-2018 in Chernyansky district. Source material for breeding was obtained as a result of expeditionary studies in the Belgorod region in different ecotopes of ravine and gully complexes, floodplains of rivers, anthropogenic-disturbed lands. Expeditionary studies were carried out within the framework of joint scientific programs of scientists of Belgorod State University with the leading federal research centers of the Russian Academy of Sciences: Williams Reserch Center for Forage Production and Agroecology, All-Russian Research Institute of Phytopathology.

We carried out individual selection of lawn-type plants: low-growing, narrow-leafed, with a large number of shoots, with high seed production [18].

Tests of breeding value of the selected forms were carried out in comparison with zoned varieties of domestic selection ('Olshanka', 'Ivitsa', 'Darina') and foreign selection ('Finelawn', 'Meandre') according to [19].

Two plots with individual plants were planted for each breeding sample. Plants were planted with a row spacing of 40 cm and a row spacing of 25 cm. Sixty plants of each breeding sample were studied.

Evaluated: Leaf: color of year of sowing, Leaf: width of year of sowing, Plant: growth habit in the autumn of the year of sowing,Stem: lengthof longest stem (inflorescence included; when fully expanded),Inflorescence: length (when fully expanded), Flag leaf: length (flagleaf on representative stem, within 2 weeks after inflorescence emergence), Flag leaf: width (flagleaf on representative stem, within 2 weeks after inflorescence emergence), Stem: length of longest stem (inflorescence included; whenfully expanded), panicle looseness, number of shoots per 1 a plant when standing alone, the number of productive shoots per plant when standing alone, the average number of seeds in one panicle, the mass of 1000 seeds.

The obtained data were processed by calculating the average, average error, coefficient of variation, limits of trait variation [20] using Exsel application statistics package.

3. Results and discussion

The varieties, taken as standards for comparison in the selection on a set of breeding traits, were chosen for a number of reasons. All of them are hexaploid varieties, were bred for use as lawn grasses, have resistance to the complex of unfavorable climatic factors, high ornamental value, according to the applicants resistant to diseases.

The Russian varieties of F. *arundinaceae* participating in the program were created by us in the Belgorod region with the participation of source material from wild local populations. The variety 'Olshanka' was obtained by individual-family selection from wild local populations in the floodplains of

the rivers Oskol and Olshanka with subsequent negative selection for 3 years with free re-pollination. Varieties 'Ivitsa' and 'Darina' were obtained by re-pollination in polycross nurseries of wild populations selected in the floodplains of the rivers Chernaya Kalitva, Oskol and Olshanka with subsequent individual and family selection according to the signs of general decorativeness (stunting, leaf plate width, leaf plate coloration), seed productivity, drought and winter hardiness on provocative background of carbonate soils.

The varieties 'Finelawn' (Denmark) and 'Meandre' (Canada) are widely used in landscape design and green construction in the Russian Federation.

The aim of breeding work with lawn grasses in the Central Black Earth zone, including F. *arundinaceae*, is to create varieties with high ornamental qualities for lawns, capable of maintaining ornamental quality under arid conditions, with high seed production, manufacturability when growing for seeds and stability in urban and technogenic landscapes.

Breeding material evaluated in this study was obtained as a result of selections, which were carried out in the floodplains of small rivers of the Belgorod region: Gostenka, Severskiy Donets, Ilyok, Vorskla, Palatovka, Chernaya Kalitva, as well as in quarries of former cement plant and former silicate plant of Belgorod.

A comprehensive study of morphological traits and productive properties of breeding populations of F. *arundinacea* from different habitats in comparison with zoned varieties was carried out to evaluate the new breeding material for suitability for use in practical turf grass breeding (Table 1).

Table 1. Characteristics of morphological characters and productive properties of F. *arundinacea* population from different habitats of the Cretaceous South of the Middle Russian Upland for breeding lawn varieties in comparison with breeding varieties

Traits	Breeding material	M±m	Cv.%	lim
Leaf: leaf coloration in the year of sowing, score	populations	5.1±1.1	29.7	3.0-7.0
	varieties	5.4±1.3	31.0	3.0-7.0
Leaf: width in the year of sowing, mm	populations	8.2±3.4	47.6	4.4-16.4
	varieties	5.9±1.4	33.3	4.8-9.4
Plant: type of bush in autumn in the year of sowing, score	populations	4.1±1.6	45.6	1.0-7.0
	varieties	3.4±1.3	49.2	1.0-5.0
Flag leaf: length, cm	populations	9.3±3.4	42.6	4.2-18.2
	varieties	5.9±1.1	24.2	4.2-8.0
Flag leaf: width, mm	populations	5.5±2.3	50.0	2.6-12.4
	varieties	3.7±0.4	14.0	3.4-4.6
Stem: stem length at full weeding, cm	populations	109.2±19.5	20.9	71.0-171.0
	varieties	102.4±15.4	18.0	85.0-128.6
Inflorescence: panicle length, cm	populations	16.4±3.6	26.9	10.2-25.0
	varieties	14.2±1.0	8.9	12.8-15.6
Inflorescence: looseness of panicle, score	populations	3.5±1.8	58.1	1.0-7.0
	varieties	2.8±1.0	53.0	1.0-5.0
Nodes: coloration, score	populations	3.5±2.0	65.4	1.0-7.0
	varieties	4.4±1.5	44.3	2.0-7.0
Shrub: number of shoots per plant, pcs.	populations	300.3±29.5	11.4	261.4-361.8
	varieties	315.2±21.6	9.5	277.0-358.0
Shrub: number of productive shoots per plant, pcs.	populations	106.7±10.5	11.4	92.6-128.8

	varieties	111.1±8.3	9.9	97.7-126.7
Seeds: number in one panicle, pcs.	populations	145.1±13.4	12.1	115.6-192.1
	varieties	137.9±3.3	3.1	132.8-143.1
Seeds: weight of 1000 seeds, g	populations	2.4±0.3	16.1	1.5-3.1
	varieties	2.3±0.1	4.9	2.3-2.5

An important indicator of the degree of variation of individual intrapopulation traits for selection was the coefficient of variation (Cv). The higher the degree of variation of a trait, the more heterogeneous source material the breeder has and he has the opportunity to select forms with the desired set of individual economically useful traits.

The sign of leaf color of F. arundinacea in autumn in the year of sowing largely determines the overall ornamental value of lawn grass and can vary in varieties from light green (3 points) to dark green (7 points). On average, breeding forms are close to regionalized varieties in this indicator. But they have a fairly high degree of intrapopulation variation, which will allow further selection on this feature.

Leaf width in the breeding forms on average 38.9 % exceeded the corresponding figure in the varieties. And if the limits of variation in released varieties were within narrow limits (4.8-9.4 mm), the breeding samples variability limits were much wider (4.4-16.4 mm).

According to the type of bush in autumn in the year of sowing, varieties of F. *arundinacea* can vary from semi-erect (3 points) to semi erect (7 points). According to this trait, the studied breeding samples and varieties were on average closer to semi-erect form, although high levels of variation coefficients indicate high intra-population variability in this trait.

Flag leaf length and width in released varieties were 36.6 % and 39.4 % lower than in individuals obtained from natural habitats. The coefficient of variation (Cv) of length and width of the flag leaf in the varieties was 24.2 % and 14.0 %, respectively. In breeding samples coefficient of variation (Cv) of length and width of the flag leaf was 42.6% and 50.0%, respectively, which makes it possible to further breed on these traits.

Stem length in lawn varieties is usually lower than in forage varieties. In our studies, the stem length of released varieties and individuals obtained from natural habitats did not differ significantly - on average 6.3 %. The coefficients of variation were also close, indicating a high probability of selection of forms with short stems among wild populations.

When selecting for high seed productivity, one of the important selection criteria is the length of the inflorescence (panicle). Wild populations exceeded released varieties by this indicator on the average by 15.5 % at high enough degree of variation of the trait (Cv = 26.9) and limits of its variability.

The traits "looseness of panicle" and "node coloring" vary widely in both breeding samples and varieties, indicating good opportunities for further breeding.

According to the number of shoots per plant, varieties and individuals obtained from natural habitats did not differ significantly, on average by 5.0 %. At the same time, in wild forms the number of shoots per plant varies in a wider range - from 261.4 to 361.8 units. But the variation coefficient is low - Cv=11.4 %.

A similar trend is observed in the number of productive shoots per plant. Significant difference, on average, also is not established. The coefficient of variation Cv = 11.4 % indicates a fairly narrow range of variation of the trait, which should be taken into account in the breeding work.

Varieties slightly differed among themselves by the number of seeds in one panicle (Cv = 3.1%). The variation range was narrow, from 132.8 to 143,1 units.

Varieties from wild populations had a wider range of variability for this trait, from 115.6 to 192.1 units (Cv = 12.1 %).

The varieties also slightly differed among themselves in 1000 seeds weight (Cv = 4,9 %) and also had narrow limits of trait variability, from 2.3 to 2.5 g.

Varieties from wild populations make it possible to carry out selection on this trait - Cv = 16.1 %, the variability limits - from 1.5 to 3.1 g.

4. Conclusion

1. It was found that the forms selected in natural habitats have wide limits of variation for all major breeding traits - Cv varied from 11.4% for traits "number of shoots per plant" and "number of productive shoots per plant" to 65.4% for the trait "node coloring".
2. Wild populations provide opportunities for selecting such important for breeding traits as "number of seeds in one panicle" and "mass of 1000 seeds" - Cv= 12.1 % and 16.1 % accordingly.
3. The results indicate the possibility of using the source material available in the collection to obtain new varieties of lawn direction with high seed productivity and ornamental value.

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