

# ***Stipa ucrainica* and *S. zalesskii* (Gramineae): Morphological and Areological Comparison<sup>1</sup>**

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**Abstract**—Feather grasses of *Stipa dasypyllea* group always were a problem group for taxonomy. In this research we performed a critical analysis of diagnostic characters used nowadays, and attempted to find new morphological characters which could make a discrimination of species of the group easier. We have shown a necessity of *Stipa ucrainica* and *S. zalesskii* distinguishing and also a distance of not-reaching a base of awn by ventral line of hairs on lemmas was non-effective character.

**Key words:** *Stipa ucrainica*, *Stipa zalesskii*, taxonomy, morphology.

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*Stipa* L. is a genus of *Stipeae* Dum. tribe which belongs to Pooideae A. Br. subfamily. The genus consists of about 300 species of perennial tussock grasses. In a territory of former USSR about 60 species can be found [1].

*Stipa* species are edificators of steppe cenoses [1–3], so it is clear that these plants should be studied. In steppes of South-East Europe *Stipa* species having plumose distant segment of awn (feather grasses) are of primary importance [2]. One of first attempts to create a taxonomic system for feather grasses inhabit European part of former USSR belongs to P.A. Smirnow. He also found principal diagnostic characters [4]. Researches of N.N. Tzvelev became the next important step in studying feather grasses. The system of N.N. Tzvelev in general was near to Smirnow's system but ranks of several taxa were different [1].

In all taxonomic systems a group of species are close related to *Stipa dasypyllea* is a source of difficulties [1, 4, 5]. In the South of European part of Russia the most widespread species of this group are *Stipa zalesskii* Wilensky and *S. ucrainica* P. Smirn. [3]. Taxonomical relationships between these two species are not clear until now: some authors even denying individuality of these taxa [6].

*S. ucrainica* was described by P.A. Smirnow in 1926 [7]. Since that time boundaries of species have not been changed. *S. zalesskii* was first described by G.D. Wilensky in 1921 [8] and in four years was very carefully redescribed by P.A. Smirnow under the name *S. rubens* P. Smirn. Later J. Martinovsky revised boundaries of this species [9].

Relying on analyzed literature sources [1, 3–13] we made brief comparison of *S. ucrainica* and *S. zalesskii*: (1) *S. ucrainica* has ventral line of hairs on lemma non-

reaching a base of awn for 1.3 mm and more; this line of *S. zalesskii* usually reaches a base of awn or does not reach for 1.2 mm and less; (2) *S. ucrainica* has long hairs on abaxial leaf surface; (3) leafs of *S. ucrainica* are less in diameter however there are races of *S. zalesskii* with thin leafs (*S. rubens* proles *rubentiformis* P. Smirn.); (4) *S. zalesskii* has pubescent sheaths of vegetative shoot leafs; (5) natural habitats of *S. ucrainica* are further west than habitats of *S. zalesskii*.

The aim of this study was to clarify taxonomic relationships of these two feather grass species in the South of European part of Russia. We have analyzed literature sources and checked diagnostic characters found in them. We also have studied exsiccate material to find out new diagnostic characters and studied distribution of these species using specimens of herbaria collections.

## MATERIALS AND METHODS

We collected plants for exsiccation in 2009 and 2010 in Rostov Region. In total we collected 71 specimen from 13 locations (Table 1).

During cameral treatment we studied five morphological characters (Table 2). We measured each specimen in five replications. Received data were processed in STATISTICA 6.1. We used non-metric multidimensional scaling and discriminant analysis to reveal groups. Then we compared groups with each other on every character using criteria of one-dimensional statistics.

We studied micro sculpture with help of Jeol JSM–6380 scanning electron microscope.

Geographical range of species we studied relying on collections of MW, MHA and herbarium of the Central chernozem Reserve (no acronym). For mapping we used program Atlas Florae Europaeae Data Editor 2010

<sup>1</sup> The article was translated by the author.

**Table 1.** Locations of material collection. *N*—number of collected specimens.

Location		Code	<i>N</i>
Nedvigovka	N 47°17'10" E 39°22'59"	S01a	5
Nedvigovka	N 47°17'02" E 39°22'54"	S01b	3
Nedvigovka	N 47°18'15" E 39°22'59"	S02	8
Bolshekrepinskaya	N 47°34'33" E 39°21'56"	S03	10
San-Manych	N 46°24'11" E 42°46'01"	S04	5
Runny	N 46°29'44" E 42°50'44"	S05	9
Strepetov	N 46°31'47" E 42°30'54"	S06	1
Protoki	N 46°35'55" E 41°50'36"	S07	2
Kurganny	N 46°36'13" E 42°47'42"	S08	2
Svobodnoe	N 46°53'31" E 44°06'39"	S09	3
Kiselevka	N 47°22'31" E 44°15'12"	S10	10 + 9
Lysogorka	N 47°43'20" E 39°12'33"	S11	2
Lysogorka	N 47°43'35" E 39°12'39"	S12	1
Andreev	N 47°02'11" E 44°12'20"	S13	1

Note: Codes correspond to point labels in Fig. 2.

**Table 2.** Morphological comparison of group 1 and group 2

Character	Group 1	Group 2
Length of lemma, mm*	17.09 ( $\pm 0.07$ )	18.83 ( $\pm 0.11$ )
Ventral line of hairs on lemma does not reach a base of awn, mm**	1.96 ( $\pm 0.11$ )	0.03 ( $\pm 0.01$ )
Pubescence of vegetative shoots leaf sheaths (marks from 0 to 2)***	0 [0 : 0]	2 [1 : 2]
Diameter of leaf, mm*	0.56 ( $\pm 0.01$ )	0.71 ( $\pm 0.01$ )
Number of hairs per length unit (2.9 mm) of leaf abaxial surface*	11.21 ( $\pm 0.37$ )	0.04 ( $\pm 0.02$ )

Note: Shown means ( $\pm$ standard error of the mean). #—shown medians [lower quartile: upper quartile]. \*—for comparison we used Student t-test. \*\*—for comparison we used Mann-Whitney U-test. In all tests p-value  $\ll 0.001$ .

which contain information about division of territory on squares according "Atlas Florae Europaea".

## RESULTS AND DISCUSSION

In the time of cameral treatment we found that noticeable pubescence develops only on lower leafs of vegetative shoots. On upper leafs of the same shoots pubescence was presented only by cilia on the edge of shoots and on ligules. Such cilia (Fig. 1) we marked out as a separate type of pubescence.

Non-metric multidimensional scaling revealed discontinuity of our data. A diagram (Fig. 2) shows a presence of two isolated groups: one is bigger and with implicit division into subgroups (hereinafter group 1) and another one is smaller (hereinafter group 2). Discriminant analysis confirmed this discontinuity and also detected the most important classification characters. These are (in the order of importance abatement) number of hairs per length unit of leaf; length of lemma; distance of non-reaching a base of awn by ventral line of hairs on lemma; diameter of leaf.

Groups we found in this way then were compared (Table 2). By all characters groups are different with high degree of significance however extremes of quantitative character always overlap.

All plants of group 2 have pubescent leaf sheaths in any case. Plants of group 1 have pubescent sheaths only in exceptional cases—we found only one vegetative shoot with scattered pubescence. But despite the pubescence that specimen had no cilia on ligule and on edge of sheaths.

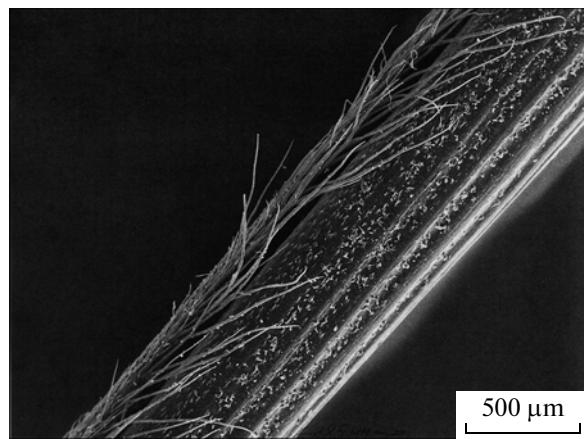
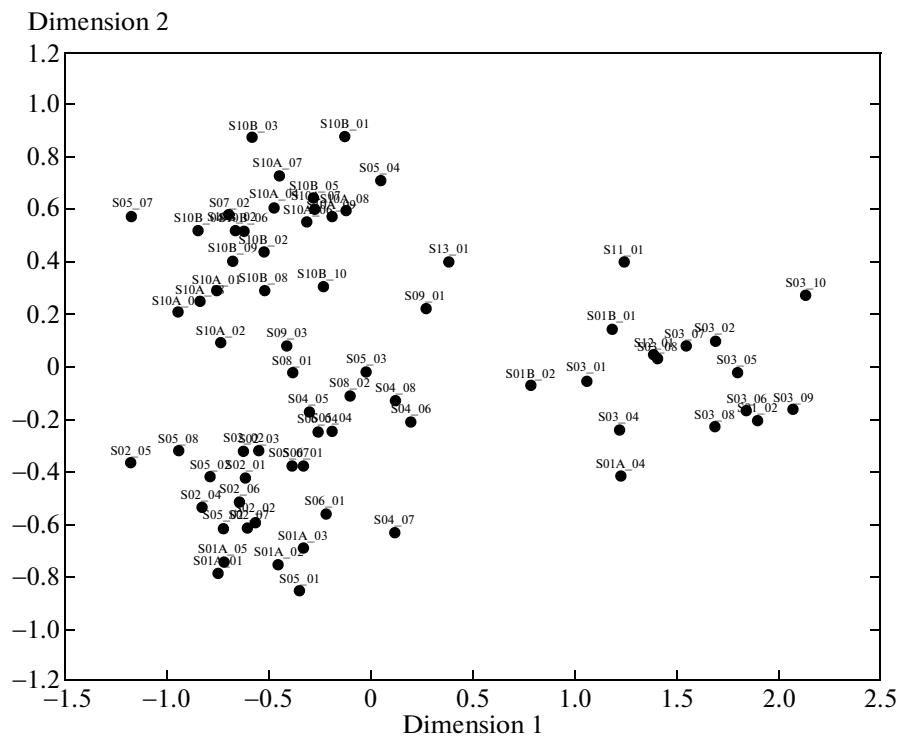
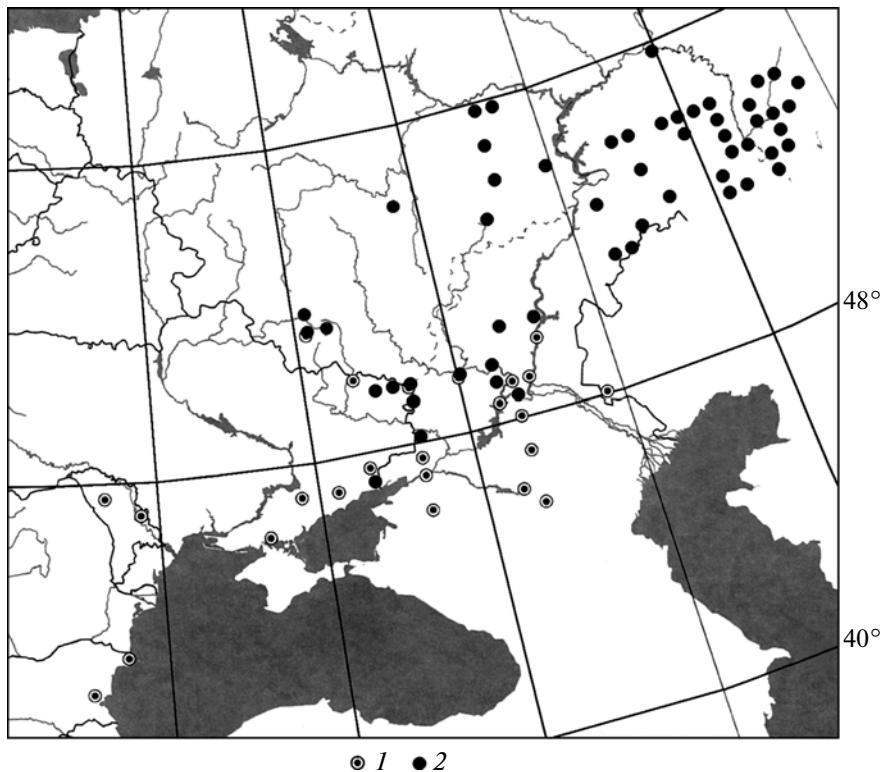


Fig. 1. Cilia on edge of vegetative shoot upper leaf sheath of plant from group 2.



**Fig. 2.** Results of non-metric multidimensional scaling.



**Fig. 3.** Map of *Stipa ucrainica* (1) and *S. zalesskii* (2) geographic ranges.

Revealed by statistical methods groups 1 and 2 completely satisfy descriptions of *S. ucrainica* and *S. zalesskii* respectively. That's why we assigned groups these names.

Regarding all characters our data agree with literature. However there is a problem with character of non-reaching ventral line of hairs on lemma a base of awn because this is the main character to distinguish concerned species in lots of determination keys [1, 3–6, 10–12]. Authors just draw the line between species in different ways and artificially bring a gap in continuous distribution of character. But the gap is absent. This might lead to mistakes in identification of certain plants. We observed intermediate values of this character in 10.1% of all examined diaspores. And four plants had different diasporas should to be ascribe to different species. Statistical methods put all these specimens into group of *S. ucrainica*. In previous studies this fact was already noticed. In detailed descriptions (but not in determination keys) often present information about high variation of this character [3–5, 11, 12]. However such notices have not changed a structure of keys until now.

In other words the most often used diagnostic character does not ensure reliable determination. But authors and statistical analysis speak in favour of existence of two species. This means a necessity to find new accurate character.

From characters we studied the character of sheaths and ligules pubescence can be used as diagnostic. This character is not continuous, its states are easy to recognize and also in this character we observed the smallest overlapping between groups (one specimen of 71 in total).

Using vouchers of specimens from herbaria as a basis we draw maps of geographic rang for *S. ucrainica* and *S. zalesskii* (Fig. 3). *S. ucrainica* is a more southern species of Black Sea region does not occur to the west of the Volga river and to the north of Kursk Region. *S. zalesskii* is more eastern and northern species; to the west of Kursk Region goes only one of its races [4, 5, 9]. Examination of *S. zalesskii* specimens have shown that cilia on sheaths edges are more noticeable in Volgograd Region and south-westward of it so this character allows to distinguish these two species in area of their geographic ranges overlap.

## CONCLUSIONS

*Stipa ucrainica* P. Smirn. and *Stipa zalesskii* Wileński are two independent species which differ morphologically and geographically.

Reliable diagnostic characters are the presence of cilia on edges of ligules and vegetative shoots leaf sheaths and number of hairs on abaxial surface of leafs. *S. zalesskii* has cilia and almost never has hairs on leafs. *S. ucrainica* does not have cilia but has a lot of hairs.

The main character used in determination keys—distance of non-reaching a base of awn by ventral line of hairs on lemma—sometimes does not allow to dis-

tinguish these two species so it should be used as a subsidiary character.

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