

PHENOTYPIC EVALUATION OF SOME SPRING NAKED OAT LINES IN THE PEDOCLIMATE CONDITIONS OF NORTH-EAST MOLDOVA

Violeta SIMIONIUC¹, Danela MURARIU², Domnica Daniela PLĂCINTĂ², Tiberiu-Emilian SÂRBU¹, Iulian GABUR¹, Dănuț-Petru SIMIONIUC¹

e-mail: simion@uaiasi.ro

Abstract

The testing of some spring naked oat lines (*Avena sativa* ssp. *nudissativa*) from the collection of the Suceava Plants Genetic Resources Bank in the pedoclimatic conditions of the Ezăreni farm in Iași county aimed to evaluate some morphological characters used both as descriptors by the Gene Banks, as well as component elements of the production capacity, in order to carry out a breeding program for this species. Thus, for the five lines tested, the values of morphological characters such as plant height, number of siblings per plant, number of spikelets per panicle, number of seeds per spikelet, number of seeds per plant and weight of seeds per plant were determined. The data were used to evaluate the intra-population variability (means, amplitude of variation and coefficients of variation) and inter-population (means and amplitude of variation), the results highlighting a pronounced variability for all the analyzed characters, both at the intra-population and inter-population level.

Key words: plant breeding, naked oat, interpopulation variation, intrapopulation variation, morphological characters

The valuable nutritional properties of oats, both for humans and for animals, make this crop occupy, globally, the seventh place within the cereal group, the most extensive areas being located in the northern hemisphere (Murariu D. *et al.*, 2017). Along with the nutritional value given by the content in proteins, vitamins, lipids and β -glucan (Shvachko N.A. *et al.*, 2021) and the high degree of digestibility, which recommends it for the nutrition of sick people or children (Bitvutskii N. *et al.*, 2019; Martinez *et al.*, 2017), oats can create added value by growing them in areas with pedoclimatic conditions less favorable for other crops or for new directions of use, such as the production of bioethanol (Skiba E.A. *et al.*, 2017). The world germplasm collections of the *Avena* genus include over 200,000 samples, most of them preserved in gene banks in Canada, the USA, Russia, Israel (Germeier C.U., 2008), of which about 1% belong to the nude form (*Avena sativa* ssp. *nudissativa*). The Suceava Plants Genetic Resources Bank maintains around 800 oat samples in its collection, most of them being represented by local populations (Murariu D. *et al.*, 2019). Evaluation of the productivity and adaptability of germplasm sources in different environmental

conditions could allow a selection of valuable forms for future breeding programs in this species.

MATERIAL AND METHOD

The biological material tested consisted of five naked spring oat lines (*Avena sativa* ssp. *nudissativa*) from the collection of the Plant Genetic Resources Bank Suceava.

In order to evaluate their behavior in the conditions of Iași County, they were sown in 2021 at the Ezăreni farm, in adjacent plots, in three rows with a length of 3 m and at a distance of 25 cm between the rows.

The sowing was done in the first decade of April; the harvesting of the plants was carried out in the last decade of July. From each line, 10 plants were retained for biometric determinations in order to evaluate the following morphological descriptors: plant height, number of tillers/plant, number of spikelets per panicle, number of seeds per spikelet, number of seeds per plant, seed weight per plant and 1000-grain weight (TKW).

For each of the five naked spring oat lines, the average values (\bar{X}), the amplitude of variation and the coefficients of variability ($s\%$) of the studied morphological characters were calculated, data that were then used to evaluate the variability of these characters at the interpopulațional level.

¹ Iași University of Life Sciences, Romania

² Vegetal Genetic Resources Bank "Mihai Cristea" Suceava, Romania

RESULTS AND DISCUSSIONS

The climate conditions of the year 2021 (*table 1*) clearly left their mark on the behavior of the oat plants. The average monthly temperatures exceeded the multiannual averages in June, July and August, and the amounts of monthly precipitation during the vegetation period of the oat plants also exceeded the area's multi-year averages.

Average plant height (*table 2*) ranged from 79.7 cm in line L-11 to 111.0 cm in line L-34. For all five lines, values of the amplitude of variation of more than 30 cm resulted, and the variability of this character registered average values in four lines, only in line L-11 resulting in a medium coefficient of variability. At the interpopulation level, the average plant height of 90.7 cm was accompanied by an average coefficient of variability of 15.3%.

The average number of tillers per plant (*table 2*) oscillated between 1.4 in the L-24 line and

3.7 in the L-89 line, the latter also registering the largest amplitude of variation. For all the five lines tested, high values of the coefficients of variability resulted and, as a consequence, also at the interpopulation level, both the coefficient of variability and the amplitude of variation had high values.

The number of spikelets per panicle (*table 2*) fluctuated very strongly in line L-11. Thus, if the plants formed, on average, 53.6 spikelets/panicle, the amplitude of variation of this character reached the value of 128 spikelets, the coefficient of variability reaching the maximum value of 62.4%. And for the other four lines, the values of the amplitude of variation exceeded the mean values of the character, so that, at the interpopulation level, the mean number of 55.9 spikelets per panicle was accompanied by a value of the amplitude of variation of 76.8 spikelets/panicle and a coefficient of variation of 42 %.

Table 1

Climatic conditions at Ezăreni-Iași in 2021 year

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
Temperature (0C)										
Mean	0.4	-0.5	3.4	8.2	15.2	19.8	23.2	21.0	14.6	9.0
Minimum	-19.6	-15.7	-7.2	-3.7	0.8	8.5	12.1	9.7	3.4	-3.2
Maximum	11.7	19.4	17.4	23.9	30.4	33.8	36.7	33.7	27.5	22.9
Multi-annual mean	-3.6	-1.9	3.3	10.1	16.1	19.4	21.3	20.6	16.3	10.1
Departure from normal	4.0	1.4	0.1	-1.9	-0.9	0.4	1.9	0.4	-1.7	-1.1
Precipitation (mm)										
Sum	26.8	22.8	65.6	56.4	87.0	115.0	71.6	155.6	12.4	5.6
Multi-annual mean	28.9	27.4	28.1	40.3	52.5	75.1	69.2	57.6	40.8	34.4
Departure from normal	-2.1	-4.6	37.5	16.1	34.5	39.9	2.4	98.0	-28.4	-28.8
Relative humidity (%)										
Mean	29.4	58.5	14.8	67.4	78.6	87.8	69.8	70.0	73.8	73.9

Table 2

Analysis of variability in plant height, number of tillers per plant and number of spikelets per panicle in spring naked oats

Line	Plant height (cm)			No. of tillers per plant			No. of spikelets on the panicle		
	Mean (\bar{X})	Amplitude of variation	s%	Mean (\bar{X})	Amplitude of variation	s%	Mean (\bar{X})	Amplitude of variation	s%
L-11	79.7 ± 5.2	44.0	20.5	1.5 ± 0.2	2.0	47.1	53.6 ± 10.6	128.0	62.4
L-24	86.6 ± 3.0	30.0	11.1	1.4 ± 0.2	2.0	49.9	48.8 ± 5.9	59.0	38.4
L-34	111.0 ± 5.3	51.0	15.2	2.9 ± 0.3	3.0	34.3	56.1 ± 7.2	57.0	40.4
L-42	80.1 ± 3.2	33.0	12.5	2.7 ± 0.4	3.0	46.4	44.7 ± 5.2	60.0	36.7
L-89	96.3 ± 5.2	58.0	17.0	3.7 ± 0.5	5.0	38.3	76.1 ± 7.7	80.0	32.0
Mean (\bar{X})	90.7	43.2	15.3	2.4	3.0	43.2	55.9	76.8	42.0
Amplitude of variation	31.3	-	-	2.3	-	-	31.4	-	-

The average number of seeds per spikelet (*table 3*) was between 1.2 in lines L-23 and L-34 and 1.6 in line L-89, for all tested lines identical values of variation amplitude and values were recorded high, very close to each other, for the coefficient of variability.

The maximum number of seeds per plant (*table 3*) was recorded at the L-89 line, and an extremely high value of the amplitude of variation was also determined for it, of 189 seeds per plant. At the opposite pole was the L-24 line, with an average number of 37.6 seeds per plant. For all five lines, high values of the coefficients of

variability resulted, so that, at the interpopulation level, this character proved to be highly variable.

Regarding the average weight of seeds per plant (*table 3*), it oscillated between 0.9 g in line L-24 and 2.1 g in line L-89, for each line resulting in very large values of the amplitude of variation and, implicitly, of the coefficients of variability.

The mass of 1000 seeds (TKW) resulting for all five lines tested (*figure 1*) was 27.8 g, the minimum value of 2.1 g found in line L-11, and the maximum value of 46.8 g, at line L-34.

Table 3

Analysis of variability in plant height, number of tillers per plant and number of spikelets per panicle in spring naked oats

Line	No. of seeds per spikelet			No. of seeds per plant			Seed weight per plant (g)		
	Mean (\bar{X})	Amplitude of variation	s%	Mean (\bar{X})	Amplitude of variation	s%	Mean (\bar{X})	Amplitude of variation	s%
L-11	1.3 ± 0.1	1.0	37.2	51.3 ± 6.8	65.0	42.1	1.1 ± 0.3	3.1	83.9
L-24	1.2 ± 0.1	1.0	35.1	37.6 ± 5.2	43.0	44.0	0.9 ± 0.2	1.2	49.5
L-34	1.2 ± 0.1	1.0	35.1	39.9 ± 6.8	64.0	53.9	1.9 ± 0.6	4.9	94.4
L-42	1.3 ± 0.1	1.0	37.2	48.5 ± 5.6	53.0	36.4	1.2 ± 0.1	1.2	30.3
L-89	1.6 ± 0.2	1.0	32.3	98.0 ± 18.4	189.0	59.5	2.1 ± 0.4	4.5	65.5
Mean (\bar{x})	1.3	1.0	35.4	55.1	82.8	47.2	1.4	3.0	64.7
Amplitude of variation	0.4	-	-	60.4	-	-	1.2	-	-

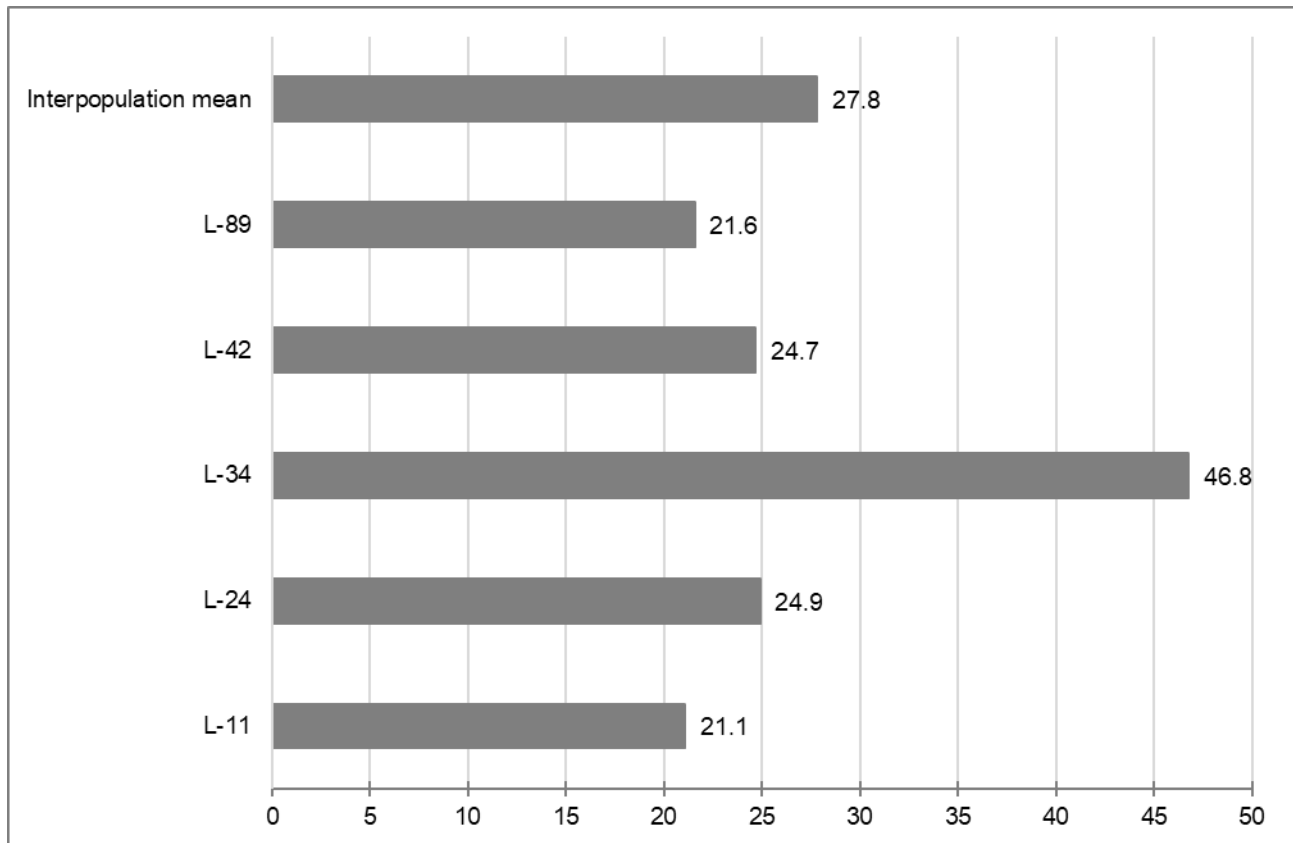


Figure 1 The weight of 1000 seeds (TKW, in g)

CONCLUSIONS

The average height of the plants of the five lines was the only character for which the coefficients of variability had medium values, an aspect that demonstrates a higher genetic stability compared to the other morphological characters analyzed.

The best tillering capacity and the highest number of spikelets per panicle were recorded in lines L-89 and L-34, in which cases the coefficients of variability, although high, were lower than those obtained for the other three cultivars. The L-89 line was characterized by the highest values of the analyzed morphological characters, except for the average height of the plants.

Even if it is an autogamous species, it is recognized that, under stress conditions, cases of allogamy or poor pollination may occur. In addition, oat spikelets detach very easily from the panicle, which may explain the high variability recorded for the number of spikelets per panicle, the number of seeds per plant and the weight of seeds per plant.

From the comparative analysis of the average values of the analyzed morphological characters, it emerged that the L-89 line presents a higher productive potential, a fact that recommends it for further testing in view of the possibility of creating a new variety of naked oat.

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