RESEARCH ARTICLE **(Open Access)**

Morphological characterization and evaluation of variability in cultivated oats *Avena sativa* L. and *Avena byzantine* C. Koch.

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Abstract

The study was carried out to characterize 32 genotypes of oat based on morphological and quality characters. The data show thatthere isgeneticvariationfor almost all the traits. Thus, the lodgingin the early stageis the sameas thatinthe stage of maturity, butitis observedthat thegenotypesare differentabout thistrait. To distinguish variation in the studied genotypes, the assessment was based on the division into five categories; 46.86% resulting lodging resistant (upright), 6.25% intermediate, while genotypes minor lodging, lodged and extremely lodged (all plants) representing 15.63% of each of them.

To trait the hairiness of leaf sheath (lower leaves), all genotypes are hairless category. For trait lemma color, they appear different genotypes where white - coffee resulting 34.37%, yellow 25%, yellow - brown 8.75% and brown 21.88%. To trait the hairiness of lemma, most ofgenotypesresultinghairless(87.5%), slightly pubescent 3.12% and moderately pubescent 9,37%. This descriptor is important to differentiate the two different species and all traits studied, can be utilized to select superior genotypes related to agronomic values. Genotypes that have a growth habit erect, the nature ofpanicle is erect and the presence of wax should be selected for abiotic stress tolerance.

Keywords: *Genotype, oat, descriptors, variability, morphological characterization*

1. Introduction

Oats, *Avena sativa* L is an important grain cultivated in different regions of the world along with wheat, maize, rice, barley and sorghum. It is usedandwidelyusedforhumanfoodandlivestock, butespeciallyasfodder. Cultivated varieties of oats are part of hekzaplloid type with 2n = 6x = 42 chromosomes originating from the union of three ancestral diploid genomes AA, CC, DD (Rines et al 2006).

The development of modern practices, optimization of natural resources and the selection of superior genotypes with desirable agronomic traits have increased yield of grain in recent decades. Oats considered a food source of protein, carbohydrates, fiber, vitamins and mineral elements, and compounds with beneficial effects on human health. (Peterson et al 2005).

The total oat production has decreased continuously, while the demand for it, as a human food has increased due to nutritional benefits of whole grain and content of b - glukonit. (Buerstmayr et al 2007). The yield of grain oat as a result of genetic improvement is up to 0.8 percent per year, depending on the country and genotype (Holland 1997). Oat genetic gain is lower than in other cereal species such as wheat and barley, which is attributed to the presence of undesirable traits in germplasm of oats as high sensitivity to disease (Stuthman 1995).

Better understanding of genetic control in connection with phenotypic changes of morph-physiological traits and qualitative-quantitative, should be seen as a fundamental step in genetic improvement programs. Assessment of genetic variability can be achieved using morphological measurements and phenotypic characterization (Greene et al 2008). Several studies clearly defined genetic control of important traits such as rust leaf (Martinelli et al 2009), sensitivity photoperiodic and flourishing (Locatelli et al 2008), tolerance to the toxicity of aluminum (Oliveira et al, 2005, Nava et al 2006), the main grain morphology (Cabral et al 2001), plant height (Marriott et al 1999) and the type of panicle (BERTAGNOLLI and Federizzi 1994).

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The purpose of this study was the characterization of some accessions of oat to different morphological features and evaluation of the variability of the collection available for proper use of germplasm.

2. Material and Methods

The experiment was conducted during 2014-2015 in the Center of Agricultural Technology Transfer Fushë Krujë. The study placed 32 domestic and foreign genotypes. The experiment is set up according to the randomized block scheme, with three replications. Observations were carried registered in 10 randomly selected plants of each genotype in three replications for twenty six morphological traits. Germplasm was characterized using descriptors oat by IPGR.

Traits of the study were: the growth habit, plant height, thickness of stem, the presence of hairs on the nodes, the angle of flag leaf to culm, the angle of leaves (other leaf than flag leaf) to culm, rigidity of flag leaf, rigidity of leaves (other than flag leaf), hairiness of leaf sheath (lower leaves), the presence of hairs on the leaf margin (leaf below flag leaf), length of second leaf from the top, the width of the second leaf from the top, shape of panicle, erectness of panicle, erectness of spikelet, the presence of wax in panicle, color lemma, the presence of hair to the lemma, covering the grain (kernel covering), the presence of awn, lodging at immature stage,lodging at mature stage, the relation between the maturity of grains and straw, the brightness of the mature seed and the total number of tillers.For all morphological traits studied the frequency distribution are calculated to draw the necessary conclusions.

3. Results and Discussion

The studyshows thatgenotypesshow awiderangeof changestoallthe morphological traitsstudied.Thefrequencydistributionfor twenty-six morphologicalcharactersis presentedin Table1.Regarding growth habit, most of genotypes are erect (81.25% or 26 accessions) followed by semi prostrate (12.5% or 4 accessions) and prostrate result 6.25% or 2 accessions. It is importantthe selection ofgenotypeswithconvenienttraitof the habitgrowth, depending onclimatic and soilconditions.The trendselectionhas evolvedover the centuriesthanks topracticalexperience. Plantswitherect habit growthcan be plantedmoredenselyand havebetter circulationofairbetween themby reducingthe possibilityof the spread offungal diseasesetc.

Intermsofmanagementof the plantit can alsohelpin determining thenutritionalareafor eachplant, easy harvestandfeasibilityto calculatethe volume ofchemicalspraying.

Based onthe characterizationof plant height, 40.63% ofplantsgenotypesaretall or 13 accessions, short34.37% or 11 accessionsandmedium 25% or 8 accessions.

Normally,the choice ofvarietiesfavorsmedium plants, becausetall plantscannotrespond toinputsandare pronetolodged, whilethe mediumplantbetter respond tothe used inputs andaremore tolerant tolodging.

At the sametime, medium heightplantswill provideenoughforagevalue, while thoseshortcanrespond welltousedinputs, notlodged,but will notprovidesufficientquantities offorage, thendo not justify theused inputs.

Forindicatorstemthickness, mediumclasspredominates(56.25%) followed bythin(25%) andthe nature ofthick(18.75%). Eventhis indicatoris favoredthose varietiesthat havemediumthickas they are moretolerant ofthe lodging.

Totraitthe presence ofhairinessin the nodes, allgenotypesareglabrouscategory.

Evenindicatorsforangle of flag leaf to culmandangle to culm of leaves (other than flag leaf),allgenotypesarethe categoryangleless than90^{o}.

Table 1.Frequency distribution of characters in oat genotypes

Nr	Character	Class	f	%
1	Growth habit	Erect	26	81.25
		Semi prostrate	4	12.5
		Prostrate	2	6.25
2	Plant height	Short	11	34.37
		Medium	8	25
		Tall	13	40.63
3	Stem thickness	Thin	8	25
		Intermediate	18	56.25
		Thick	6	18.75
4	Node hairiness	Glabrous	32	100
		Slightly pubescent	0	0
		Moderately pubescent	0	0
		Highly pubescent	0	0
5	Angle of flag leaf to culm	Acute (< 90^o)	32	100
		Intermediate (about 90^o)	0	0
		Obtuse (> 90^o)	0	0
6	Angle to culm of leaves (other than flag leaf)	Acute (< 90^o)	32	100
		Intermediate (about 90^o)	0	0
		Obtuse (> 90^o)	0	0
7	Rigidity of flag leaf	Bent	3	9.38
		Slightly bent	18	56.25
		Stiff	11	34.37
8	Twisting of leaves	Twisting left	32	100
		Twisting right	0	0
9	Hairiness of leaf sheath (lower leaves)	Glabrous	32	100
		Slightly pubescent	0	0
		Moderately pubescent	0	0
		Highly pubescent	0	0
10	Hairiness of leaf margin (leaf billow)	Glabrous	25	78.12
		Slightly pubescent	7	21.88
		Moderately pubescent	0	0
		Highly pubescent	0	0
11	Length of second leaf from top	Short	5	15.63
		Medium	11	34.37
		Long	16	50
12	Width of second leaf from top	Narrow	9	28.13
		Medium	11	34.37
		Broad	12	37.5
13	Lodging at immature stage	Upright (all plants)	15	46.86
		Minor lodging	5	15.63
		Intermediate	2	6.25
		Lodged	5	15.63
		Extremely lodged (all plants)	5	15.63
14	Lodging at mature stage	Upright (all plants)	15	46.86
		Minor lodging	5	15.63
		Intermediate	2	6.25
		Lodged	5	15.63
		Extremely lodged (all plants)	5	15.63
15	Shape of panicle	Unilateral	1	3.12
		Equilateral	31	96.88
16	Erectness of panicle	Drooping	0	0
		Semi-erect	0	0
		Erect	32	100
17	Angle of panicle branches to the main axis	Extremely low (panicle branches erect)	3	9.38
		Acute	11	34.37
		Intermediate	15	46.87
		Obtuse	3	9.38
18	Erectness of spikelets	Drooping	32	100
		Semi – erect	0	0
		Erect	0	0
19	Waxiness of the panicle	Absent	0	0
		Present	32	100
20	Relation between maturity of grains and straw	Grain ripe before straw	32	100
		Simultaneous	0	0
		Straw ripe before grain	0	0

21	Lemma color	White to brawn Yellow Yellow to brawn Brawn Black Other	11 8 6 7 0 0	34.37 25 18.75 21.88 0 0
22	Hairiness of lemma	Glabrous Slightly pubescent Moderately pubescent Highly pubescent	28 1 3 0	87.5 3.13 9.37 0
23	Kernel covering	Grains covered Grains naked	32 0	100 0
24	Awnedness	No awns Weak awns Strong awns	21 1 10	65.62 3.13 31.25
25	Grain shedding at maturity	Low Intermediate High	2 16 14	6.25 50 43.75
26	Number of tillers	Few Intermediate Many	5 18 9	15.62 56.25 28.13

For indicator the rigidityof flagleaf, genotypespresentvariabilityandthe majority ofgenotypesareslightlybentcategory(56.25%), followed by thestiff category(34.37%) andbent(breaking) 9.38%.

Allgenotypes, totraitthe presenceof hairsonthe leaf sheath,wereglabrouscategory. Forindicator, presenceof hairsonthe leaf margin, glabrouscategorypredominates(78.12%), followed byslightly pubescentcategory(21.88%).

Forthe lengthof the second leaffrom top, under theflagleaf, the genotypespresentsignificantvariability.

Mostgenotypesarelongleaves(50%) followed bythosewithmedium leaves(34.37%) and shortleaves15.63%.

Even the indicator the width of the leaf, has variability between genotypes. With broad leaves results 37.5% followed by that medium (34.37%) and narrow 28.13%. Both indicators are important in selection job, as they are directly related to leaf surface (surface assimilation), and consequently with grain or forage production.

For indicator lodging, as in the immature stage and mature, no change in genotype, while there are differences between genotypes. Thus upright category is predominant (46.86%) or 15 numbers (accessions), followed by minor lodging, lodging and extremely lodged the same value (15.63%) or five genotypes each, and 2 genotypes or 6.25% are intermediate lodging category.

The shape of panicle resulted to be, equilateral 96.88% or 31 genotypes and unilateral one genotype or 12.3%, whereas the erectness of panicle for all genotypes appears to be the erect panicle.

For indicator the angle of panicle branches to the main axis, the genotypes represent the differences between them. The assessment is made in four categories, of which 3 numbers or 9:38% are extremely low angle (panicle branches erect), 11 genotypes or 34.37% with acute angle, 15 numbers or 46.87% intermediate angle, and 3 numbers or 9:38% obtuse angle. All genotypes, for erectness of spikelet are drooping category. Indicator for the waxiness of the panicle, all genotypes had the presence of wax in panicle.

4. Conclusions

Based on,the characterization, relation between maturity of grains and strawallanalyzedgenotypesresulting inthe grainripe before straw.

The indicatorlemma colorhavethis categorization: genotypeswith the colorwhite tobrown11or34.37%, yellow 8or25%, yellow tobrown6or18.75% andbrown7genotypesor21.88% andnone ofthe genotypesdid notcolorwhiteor black.

For indicator presence of hairs on the basis of grain (lemma) most genotypes were glabrous, 87.5% or 28 numbers, a genotype was slightly pubescent and 3 with moderately pubescent.

None of genotypes was highly pubescent. This indicator is important in the determination of the species, genotypes with the presence of hairs on the basis of grain belong to byzantine species.

Basedon, the indicatorthe presence ofawn, in the most genotypesdominates the categorywithout awns 65.62% or21numbers,agenotypewithweak awnsand10genotypeswithstrongawnsor31.25%.

Forindicatorgrains shedding at maturity 6.25% or 2 numbers arelowshedding,intermediate shedding16numbers or50%, and high shedding14numbers or43.75%.

For the total number of the tillers evaluation is conducted in three categories and dominates the category, intermediate tiller with 18 genotypes or 56.25%, followed by the category of high tiller with 9 genotypes or 28.13% and low tiller are 5 genotypes or 15.16%.

This indicatoris particularly importantinthe jobselectionto separate thegenotypesaccording to the purposeofcultivation,grain(concentrate), fodder, orforbothgrainand fodderpurposes.

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