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CHARACTERIZATION OF OAT (*AVENA SP*) GENOTYPES FOR MORPHOLOGICAL TRAITS

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SUMMARY

Fifty oat genotypes belonging to eight different *Avena species*, were characterized on the basis of observations recorded for seven different qualitative characters as per the guidelines for the conduct of test for Distinctiveness, Uniformity and Stability. The observations were recorded on five randomly selected plants in each genotype for the following seven qualitative traits *viz*., leaf colour, growth habit, stem colour, awn-ness, awn colour, panicle shape and panicle branch position. On the basis of leaf colour the genotypes were classified into the light green (nine), green (37) and dark green (four). Plant growth habit of 50 genotypes were classified in three groups erect (29), semi prostrate (13) and prostrate (eight). Based on stem colour there were three groups *viz.* light purple (seven), purple (11) and green (32). Similarly, out of 50 genotypes of oat, 23 had no awns, 24 had one awn and three had two awns. The 24 genotypes with awns were also classified on the basis of awn colour into yellow and black, 12 genotypes had yellow awn whereas 15 had black awn. Panicle shape categorized the oat germplasm into two groups *i.e*. equilateral (27) and unilateral (23). Panicle branch position 50 genotypes were classified in five categories on the basis of panicle branch position erect (15), semi erect (13), horizontal (eight), drooping (12) and strongly drooping (two). The outcome of these traits tells us about the genetic architecture of the genotypes and their interaction within a specified environment for further improvement.

Key Words : Oat, characterization, DUS, morphological traits

Oat (*Avena sativa* L.), ranked 6th in the world cereal production, is an important annual crop of *rabi* season. The genus *Avena* is very large and diverse and includes diploid, tetraploid and hexaploid species (Kaur and Kapoor, 2017). Genetic improvement of a crop depends upon the extent and magnitude of genetic variability present in the economic characters. Study of variation present in the characters of agronomic importance within large collection of materials is required to use the valuable genotypes for crop improvement programme (Jaipal and Shekhawat, 2016). Assessment of the genetic variability can be achieved using morphological measurements and phenotypic characterization. Very good information on sources of germplasm, various descriptors, data on various morphological traits and characterization of oat germplasm on the basis of morphological traits has been well documented (Choubey *et al.* 2005).

Characterization of genotypes is the recording of distinctly identifiable characteristics which are highly heritable whereas evaluation refers to the agronomic description of the genotypes, for the traits, that are generally important to breeders and researchers in crop improvement. Both are needed to understand the genetic relationship among the genotypes so that they may be deployed effectively in oat breeding programme. So these are crucial for varietal development, identification and release.

Plant morphology has been in use since very long time. Morphological descriptors can provide a unique identification of cultivated varieties. These plant characters form the basis for the breeder's selection of promising plant material. The morphological traits are used mainly for identification of genotypes and varieties. These descriptors reflect not only the genetic constitution of the variety, but also the interaction of the genotypes with the environment within which it is expressed.

MATERIALS AND METHOD

The present investigation was conducted at Forage Research Area, Department of Genetics and Plant Breeding, Chaudhary Charan Singh Haryana Agricultural University, Hisar (Haryana, India) during *rabi* 2015-16. The experiment was conducted in

randomized block design with three replications and two row plot of three metre each. Standard recommended agronomical package of practices were followed.

The climate of Hisar is semi-arid and subtropical with hot and dry winds during summer months. Warm humid in monsoon and cold dry weather in winter are the general features of this region. Both, winter and summer are usually harsh to bear upon. The mean minimum and maximum temperature exhibit wide variations. A maximum temperature zooming 44 to 48ºC during summer and temperature dipping as low as to freezing point accompanied with chill frost in winter is of common occurrence.

The experimental material comprised of 50 oat genotypes, belonging to eight different *Avena species*, from oat germplasm. These genotypes included released varieties, advanced breeding lines and genetic stocks *etc* (Table 1).

Oat germplasm lines were characterized and grouped into different classes on the basis of observations recorded as per the guidelines for the conduct of test for distinctiveness, uniformity and stability on oat by International Union for the Protection of New Varieties, (UPOV, 1994) for morphological characters at different stages of plant growth.

The observations were recorded on five randomly taken plants in each genotype for the following seven qualitative traits *viz*., leaf colour (Colour of the leaf on the main tiller was recorded 30 days after sowing and classified into green, dark green and light green), growth habit (recorded at juvenile stage (25-29 days) on the basis of visual scoring and classified into erect, semi-prostrate and prostrate), stem colour (Stem colour of the main tiller was recorded 30 days after sowing and classified into green, light purple and purple), awn-ness (presence or absence of awn and classified as awnless, one awn or two awn), awn colour (yellow and black), panicle shape (equilateral and unilateral) and panicle branch position (erect, semi-erect, horizontal, drooping and strongly drooping).

RESULTS AND DISCUSSION

Leaf colour : Leaf color comes from pigments which are natural substances produced by leaf cells. Chlorophyll pigment, produces green colour, is the most important of the three. Without the chlorophyll in leaves, plants wouldn't be able to use sunlight to produce food. Leaf characters, like foliage colour are observed to be quite useful in the classification of oat

TABLE 1
List of genotypes of oat used in the study

S. No.	Genotype	Species	S. No.	Genotype	Species
1.	HFO 33	*Avena sativa*	26.	HFO 503	*Avena sativa*
2.	HFO 41	*Avena sativa*	27.	HFO 512	*Avena sativa*
3.	HFO 47	*Avena sativa*	28.	HFO 513	*Avena sativa*
4.	HFO 49	*Avena sativa*	29.	HFO 681	*Avena sativa*
5.	HFO 50	*Avena sativa*	30.	HFO 682	*Avena sativa*
6.	HFO 52	*Avena sativa*	31.	HFO 684	*Avena sativa*
7.	HFO 53	*Avena sativa*	32.	HFO 685	*Avena sativa*
8.	HFO 55	*Avena sativa*	33.	HFO 716	*Avena sativa*
9.	HFO 56	*Avena sativa*	34.	HFO 833	*Avena sativa*
10.	HFO 58	*Avena barbata*	35.	HFO 834	*Avena sativa*
11.	HFO 59	*Avena sativa*	36.	HFO 864	*Avena brevis*
12.	HFO 60	*Avena byzantina*	37.	HFO 867	*Avena maroccana*
13.	HFO 103	*Avena orientalis*	38.	HFO 868	*Avena sativa*
14.	HFO 114	*Avena sativa*	39.	HFO 870	*Avena vaviloviana*
15.	HFO 233	*Avena sativa*	40.	ALGERIAN	*Avena sativa*
16.	HFO 239	*Avena sativa*	41.	JHO 851	*Avena sativa*
17.	HFO 305	*Avena nuda*	42.	JO 1	*Avena sativa*
18.	HFO 306	*Avena sativa*	43.	PLP 1	*Avena sativa*
19.	HFO 307	*Avena sativa*	44.	UPO 212	*Avena sativa*
20.	HFO 346	*Avena sativa*	45.	KENT	*Avena sativa*
21.	HFO 476	*Avena sativa*	46.	OS 6	*Avena sativa*
22.	HFO 488	*Avena sativa*	47.	OS 7	*Avena sativa*
23.	HFO 489	*Avena sativa*	48.	OS 377	*Avena sativa*
24.	HFO 490	*Avena sativa*	49.	OS 403	*Avena sativa*
25.	HFO 502	*Avena sativa*	50.	HJ 8	*Avena sativa*

genotypes. Among the experimental materials 37 genotypes were green, nine were light green and four were dark green (Plate 1; Table 2).

A study of morphological characters revealed the plant growth habit, colour of stem, stem solidness, leaf type, colour of leaf sheath, flag leaf angle, shape of panicle, colour of panicle, hairiness of lowest joint of panicle, colour of node and hair above or below the node were found to be important diagnostic characters for varietal identification in oat by Kumar *et al*. (2002).

Plant growth habit : Growth of the plants is affected by the genetic factors as well as the environmental conditions. The plant growth habit characteristics are most important morphological marker to distinguish different types of oat. The 29 genotypes were erect, 13 genotypes semi-prostrate and remaining eight genotypes had prostrate growth habit (Plate 2; Table 3).

Arora (2013) evaluated 180 germplasm accessions of oat for various morphological and yield traits *viz*., growth habit (erect, semi-erect or semi-prostrate), foliage colour (light green, green or dark green), plant stature (dwarf, semi-dwarf or tall type), panicle shape (equilateral, non-equilateral or flag type) and awn (presence or absence).

Stem colour : On the basis of stem colour, the genotypes were classified in three categories green (32 genotypes), light purple (7 genotypes) and purple (11 genotypes) given in Table 4.

Kiec (1995) also differentiated several dozen oat varieties by morphological character of plant. Parkash (1998) had also classified different genotypes of oat on the basis of morphological characters of

Light Green **Green** **Dark Green**

Plate 1. Three distinct leaf colours.

TABLE 2
Classification of oat genotypes on the basis of leaf colour

Light green (9)	HFO 58, HFO 60, HFO 346, HFO 870, JO 1, Kent, OS 6, OS 7, UPO 212
Green (37)	HFO 41, HFO 47, HFO 49, HFO 50, HFO 52, HFO 53, HFO 55, HFO 59, HFO 103, HFO 114, HFO 233, HFO 239, HFO 305, HFO 306, HFO 488, HFO 489, HFO 490, HFO 502, HFO 503, HFO 512, HFO 513, HFO 681, HFO 682, HFO 684, HFO 685, HFO 716, HFO 833, HFO 834, HFO 864, HFO 867, HFO 868, Algerian, HJ 8, JHO 851, OS 377, OS 403, PLP 1
Dark green (4)	HFO 33, HFO 56, HFO 307, HFO 476

Erect **Semi-prostrate** **Prostrate**

Plate 2. Classification of Plant Growth habit.

TABLE 3
Plant growth habit observed in oat genotypes

Erect (29)	HFO 33, HFO 41, HFO 47, HFO 49, HFO 53, HFO 55, HFO 56, HFO 58, HFO 59, HFO 60, HFO 103, HFO 305, HFO 306, HFO 307, HFO 476, HFO 503, HFO 512, HFO 684, HFO 685, HFO 834, HFO 864, HFO 868, Algerian, HJ 8 , JHO 851, JO 1, OS 377, OS 403, UPO 212
Semi-prostrate (13)	HFO 50, HFO 52, HFO 233, HFO 239, HFO 346, HFO 489, HFO 490, HFO 502, HFO 681, HFO 682, Kent, OS 6, OS 7
Prostrate (8)	HFO 58, HFO 60, HFO 867, HFO 870, HFO 114, HFO 488, HFO 716, PLP 1

plants. Eleven varieties of oats were studied and characterized by Sumathi and Balamurugan (2014) to know the various morphological characters for identification. Chakraborty *et al*. (2014) classified the oat genotypes on the basis of growth habit, leaf colour, colour of panicle, stem girth, panicle length, colour of awn, awn nature, lemma colour and lemma hairiness.

Awn-ness : The palea in an oat flower may be awned or awnless. On the basis of presence/absence of awns, the oat genotypes were classified into three categories *viz*. no awn, one awn or two awns. Out of 50 oat genotypes, 23 had no awns, 24 had one awn and three had two awns (Plate 3; Table 5).

One Awn **Two Awn**

Plate 3. Presence of awns.

TABLE 4
Variation in stem colour in oat genotypes

Green (32)	HFO 33, HFO 41, HFO 47, HFO 52, HFO 55, HFO 56, HFO 58, HFO 103, HFO 114, HFO 239, HFO 305, HFO 476, HFO 489, HFO 490, HFO 512, HFO 684, HFO 716, HFO 833, HFO 834,HFO 864, HFO 867, HFO 870, HJ 8, Algerian, JHO 851, Kent, OS 6, OS 7, OS 377, OS 403, PLP 1, UPO 212
Light purple (7)	HFO 49, HFO 50, HFO 53, HFO 306, HFO 307, HFO 681 HFO 685
Purple (11)	HFO 59, HFO 60, HFO 233, HFO 488, HFO 502, HFO 503, HFO 513, HFO 682, HFO 868, HJ 8, JO 1

TABLE 5
Presence or absence of awns in oat genotypes

No awn (23)	HFO 49, HFO 50, HFO 52, HFO 53, HFO 55, HFO 103, HFO 233, HFO 305, HFO 346, HFO 476, HFO 502, HFO 513, HFO 681, HFO 684, HFO 685, HFO 716, HJ 8, JHO 851, JO 1, Kent, OS 377, OS 403, UPO 212
One awn (24)	HFO 33, HFO 41,HFO 47, HFO 56, HFO 58, HFO 59, HFO 60 HFO 114, HFO 239, HFO 306, HFO 488, HFO 489, HFO 490, HFO 503, HFO 512, HFO 682, HFO 833, HFO 834, HFO 864, HFO 867, Algerian, OS 6, OS 7, PLP 1
Two awns (3)	HFO 307, HFO 868, HFO 870

TABLE 6
Oat genotypes with varied awn colours

Yellow (12)	HFO 41, HFO 47, HFO 56, HFO 239, HFO 306, HFO 489,HFO 512, HFO 682, HFO 833, HFO 867, OS 6, OS 7
Black (15)	HFO 33, HFO 58, HFO 59, HFO 60, HFO 114, HFO 307, HFO 488, HFO 490, HFO 503, HFO 834, HFO 864, HFO 868, HFO 870, Algerian, PLP 1

TABLE 7
Different panicle shapes in fifty genotypes of oat

Equilateral (27)	HFO 33, HFO 41, HFO 47, HFO 49, HFO 50, HFO 55, HFO 58, HFO 59, HFO 60, HFO 239, HFO 306, HFO 307, HFO 476, HFO 490, HFO 513, HFO 681, HFO 682, HFO 685, HFO 833, HFO 864, HFO 868, HFO 867, HFO 867,Algerian, JHO 851, OS 6, OS 7
Unilateral (23)	HFO 52, HFO 53, HFO 56, HFO 103, HFO 114, HFO233, HFO 305, HFO 346, HFO 488, HFO 489, HFO 502, HFO 503, HFO 512,HFO 684, HFO 716, HFO 834, HJ 8, JO 1, Kent, OS 377, PLP 1, UPO 212, OS 403

TABLE 8
Position of panicle branch in oat genotypes

Erect (15)	HFO 41, HFO 47, HFO 49, HFO 50, HFO 52, HFO 58,HFO 239, HFO 306, HFO 476, HFO 488, HFO 503, HFO 513, HFO 682, HFO 684, PLP 1
Semi erect (13)	HFO 33, HFO 59, HFO 346, HFO 489, HFO 502, HFO 512,HFO 681, HFO 716, HFO 833, HFO 864, HFO 868, Algerian, JHO 851
Horizontal (8)	HFO 55, HFO 60, HFO 307, HFO 490, HFO 834, HFO 867, OS 6, OS 7
Drooping (12)	HFO 53, HFO 103, HFO 114, HFO 233, HFO 305, HFO 685, HFO 870, HJ 8, Kent, OS 377, JO 1, UPO 212
Strongly drooping (2)	HFO 56, OS 403

Equilateral **Unilateral**

Plate 4. Panicle shape variation.

Awn colour : The oat genotypes were classified into two groups on the basis of awn colour *i.e*. yellow (12) and black (15). See Table 6.

Panicle shape - A panicle is a much-branched inflorescence. On the basis of panicle shape, the 50 genotypes of oat were classified into two groups equilateral (27) and unilateral (23) as shown in Plate 4; Table 7.

Panicle branch position : The 50 oat genotypes were classified into five categories on the basis of panicle branch position erect (15), semi erect (13), horizontal (eight), drooping (12) and strongly drooping (two). The classification of genotypes has been presented in Table 8.

The genotypes studied in the present investigation exhibited a wide range of variation for various characters observed. Evaluation of germplasm is an important step in plant breeding so that the genotypes having inherent ability for different traits can be selected which suggested ample scope of improvement by inclusion of yield and quality characteristics of oat.

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