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Raj Kumar
CSA University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

RP Vyas
CSA University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

HC Singh
CSA University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Smriti Varghese
CSA University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Gaurav Mishra
CSA University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Vivek Kumar
SVP University of Agriculture and Technology, Meerut, Uttar Pradesh, India

Anjali
SVP University of Agriculture and Technology, Meerut, Uttar Pradesh, India

Corresponding Author:
Vivek Kumar
SVP University of Agriculture and Technology, Meerut, Uttar Pradesh, India

Study of genetic variability to emphasize breeding programme for fodder and grain yield in oat genotypes

Raj Kumar, RP Vyas, HC Singh, Smriti Varghese, Gaurav Mishra, Vivek Kumar and Anjali

Abstract
The goal of this study was to determine the presence of genotypic variability in order to mark suitable genotypes for fore coming breeding programmes. The current study was conducted during the rabi seasons of 2021 at the CSAUA&T, Kanpur. The experiment was set up in a three-replication randomized block design, with a plot size of 3 x 1 m2 and row-to-row and plant-to-plant spacing of 30 and 5 cm, respectively. For all of the agro morphological features tested, analysis of variance observed that the mean sum of square due to genotypes was significant. The PCV estimations were higher than the GCV estimates, indicating that the environment had an impact. With the exception of days of 50 percent flowering all characters had strong PCV and GCV. For all 12 characters, high heritability values were found. For plant height, leaf area, and fresh weight, there was a high heritability combined with a high genetic advance. These characters having high heritability govern with high genetic advance can be used in breeding programme for oat improvement.

Keywords: Analysis of variance, heritability, variability, genetic advance

Introduction
The common oat (*Avena sativa* L.) is a cereal crop grown primarily for its green fodder and grains. Oats grains are suitable for human consumption whereas green and dry fodder is used as livestock feed. It belongs to family Poaceae and has three naturally occurring Ploidy Levels namely; diploid (2n=2x=14 having A and C genome), tetraploid (2n=4x= 28 with AB and AC genome) and hexaploid (2n=6x=42 containing ACD genome) (Loskutov, 2008) [13]. Oat is grown in 25.3 m ha area of the world producing 49.6 mt. of grains globally with a productivity of 1963 kg per hectare. The country's total oat-growing area is estimated to be around 5,000 acres. Uttar Pradesh has the most area under cultivation (34 percent), followed by Punjab (20 percent), Bihar (16 percent), Haryana (9 percent), and Madhya Pradesh (6 percent) (IGFRI, 2019). Whole (unhusked) oats produce/feeds have a high protein (12%), fat (5%), fibre (12–15%), and carbohydrate content when compared to other grains (about 64 percent). Oat green fodder contains 20% dry matter, 10% crude protein and 91% organic matter. Oat straw is more nutritious and palatable than wheat straw as well as an important supplementary feed. It contains high amount of important vitamins and minerals such as vitamin E, Vitamins B, calcium, phosphorus, magnesium and potassium. The amino acid profile of proteins in oats kernel is considered to be in perfect proportion (Nanda *et al.*, 2017) [14]. Oat protein is nearly equivalent in quality to soy protein, meat, milk and egg proteins which has been reprted by WHO. The protein content of the hull-less oat kernel ranges from 12 to 24 per cent, which is the highest among cereals (Lasztity, 1999) [12]. It includes total dietary fibre, including the soluble fibre glucan, and is high in antioxidants such as tocotrienol, tocopherol, and avenanthramides, unlike other cereal grains such as wheat and barley (Oliver *et al*., 2010) [15]. Animal feeding systems are primarily based on grazed native grasslands, which are declining in terms of productivity and quality, as well as varying seasonally, resulting in poor animal performance. Despite the importance of livestock, poor animal nutrition is a prevalent problem in developing nations and a key stumbling block to the development of viable livestock industry. In India, the available feed supply is only one-third of what animals require (Younas and Yaqoob 2005) [19]. Developing county facing major challenges like under nutrition for both human being and animals. Inspite of oat having high nutrition for food as well as feed compared to other cereals like wheat and rice, oat had not got much attention of researcher for its improvement. Low production of crop due to several biotic and abiotic stress.

Slow progress of oat improvement is cause due to lack of study about germplasm which have high variability for stress as well as yield potential. This study focused to explore the genetic variability present in 38 germplasm in order to increase the speed of oat improvement.

Material and Methods

The current study was conducted during the rabi seasons of 2021 at the CSAUA&T, Kanpur, student instructional farm plot No. 41. The 38 genotypes were obtained from the Jhansi-based Indian Grassland and Fodder Research Institute. The experiment was set up in a three-replication randomised block design, with a plot size of 3 x 1 m2 and row-to-row and plant-to-plant spacing of 30 and 5 cm, respectively. Observations recorded for Days to 50% flowering, plant height (cm), tillers per plant, leaves per plant, leaf length(cm), leaf width(cm), fresh plant weight (g), leaf area (cm2), leaf area index, dry weight/plant (g), HI (percent), and grain yield per plant (g) were all measured on three randomly selected competitive plants in each replication. The data was statistically evaluated according to the instructions provided by (Panse and Sukhatme 1985) [16]. The genotypic, phenotypic, and environmental coefficients of variation were estimated using Burton and De Vane's methodology (1953) [3]. The projected genetic advance (GA) resulting from the selection of 5% superior individuals was computed according to Burton and De Vane (1953) [3] and Johnson *et al*., (1955) [10] and heritability in the broad sense (h2bs) is calculated as the ratio of genotypic variance to the sum of phenotypic variance. The following limits were randomly applied to categorise the magnitude of certain parameters (Searle, 1965 and Johnson, 1955) [10].

Result and Discussion

The following are some of the components of the current study that have been discussed: analysis of variance, Genotypes' average performance, Variability parameters such as the phenotypic and genotypic coefficients of variation. Analysis of variance for all of the agro morphological features tested, analysis of variance demonstrated that the mean sum of square due to genotypes was significant (Table.1). According to Kumar *et al*. (2004) [11], analysis of variance revealed substantial variations in all of the germplasm lines for all of the traits. Jaipal and Shekhawat (2016) [9] have also reported on the significance degree accordance to this experiment observation. Mean genotype performance and variability of characters and potential genotype for each character are given in table 3. Knowledge of the PCV and GCV proved useful in forecasting the amount of variation present in a given genetic material, which aids in the development of an effective breeding programme. For all of the variables (Table.2), the PCV estimations were larger than the corresponding GCV, indicating that the apparent variation was attributed not just to genetics but also to the influence of the environment. Similar findings were reported by Gautam *et al.*, (2006) [7], Bind *et al*, (2016) [2], Dar *et al*.,(2004) [5]. High PCV and GCV (>15%) was observed for characters *viz.*, Plant Height(cm), Tillers per Plant, Leaf per Plant, Leaf Length (cm), Leaf Width(cm), Fresh Weight (g),Leaf area(cm2), Leaf area Index, Dry Weight (g.),Harvest index (g), Grain Weight (g).Low PCV and GCV (<10%) was observed for days to 50% flowering. Bibi *et al*., (2012) [1], Dubey *et al*., (2014) [6] Bind *et al.*, (2016) [2]. Heritability, in general, was extremely important to breeders since its size reflects the consistency with which a genotype can be identified by its phenotypic manifestation (Lush, 1945). All parameters, plant height (cm), tillers per plant, leaves per plant, leaf length(cm), leaf width(cm), fresh weight (g), leaf area(cm2), leaf area index, dry weight (g), harvest index (g), days to 50% flowering, grain weight were found to have strong heritability (>70%) in the current study (g). Bind *et al*., (2016) [2]. Choubey *et al*., (2001) [4]. Knowing the estimations of heredity or genetic progress was insufficient for an efficient selection programme. It was more beneficial to study genetic progress in conjunction with heritability. As a guiding element for breeders in diverse selection programmes, genetic progress has an advantage over heredity. Because both heredity and high genetic variability were needed to achieve higher genetic gain, genetic advance may or may not be proportional to genetic variability and heritability estimations. For plant height, leaf area (cm2), and fresh weight, high genetic advance were observed (>20 percent).Moderate (15-20%) for leaf per plant, dry weight, whereas low (<15%) for characters such as days to 50% flowering, tillers per plant, leaf width, leaf length, leaf area index, harvest index, grain weight. For plant height, leaf area (cm2), and fresh weight, high heritability was detected together with substantial genetic progress, indicating that additive gene action predominates. For days to 50% flowering, tillers per plant, leaf width, leaf length, leaf area index, harvest index, grain weight, and days to 50% flowering, high heritability with low genetic advance was observed, indicating non-additive gene action and revealing the importance of dominance and epistasis effects in the inheritance of these traits. Bind *et al*.,(2016) [2], Roy *et al*., (2013) [17].

Table 1: The 12 characters in oat were subjected to an analysis of variance.

S.V	D. F.	Mean Sum of Square											
		1	2	3	4	5	6	7	8	9	10	11	12
Replication	2	41.12	1.48	18.97	6.64	0.12	38.75	22640.00	6.31	14.94	0.14	7.43	2.05
Treatment	37	888.60	17.32	265.38	118.48	0.43	4869.78	28153 36.4	14.33	262.42	102.44	69.30	56.70
Error	74	2.72	1.22	17.91	1.23	1.09	92.64	19740.64	3.88	2.14	6.29	1.93	0.45

1. Plant height (cm)
2. Tillers per plant
3. Leaves per plant
4. Leaf length (cm)
5. Leaf width (cm)
6. Fresh weight (g)
7. Leaf area (cm^2)
8. Leaf area index
9. Dry weight (g.)
10. Harvest index (g)
11. Days of 50% flowering
12. Grain weight (g)

Table 2: Estimates of variable parameters for oat grain yield and quality attributes.

Character	Mean	Range (Min-Max.)	PCV (%)	GCV (%)	Heritability (%)	GA
Plant height(cm)	95.1228	52.00-134.67	18.15	18.07	99.1	35.24
Tillers per plant	7.85	4.00-13.67	32.70	29.51	81.5	4.31
Leaves per plant	34.50	18.33-59.33	29.04	26.33	82.2	16.96
Leaf length(cm)	41.48	30.00-53.00	15.31	15.07	96.9	12.68
Leaf width(cm)	2.01	1.27-2.87	19.43	18.73	92.9	0.75
Fresh weight (g)	114.78	56.33-197.33	35.76	34.77	94.5	79.91
Leaf area(cm^2)	2098.36	631.00-4346.33	46.49	46.00	97.9	1967.85
Leaf area index	4.70	1.43-9.65	46.60	46.42	99.2	4.48
Dry weight (g.)	29.19	20.00-50.67	32.30	31.91	97.6	18.96
Harvest index (g)	32.93	17.56-46.25	17.75	17.74	99.8	12.02
Days of 50% flowering	87.69	79.33-97.00	5.63	5.40	92.1	9.37
Grain weight (g)	14.05	6.00-27.33	31.18	30.81	97.6	8.81

Table 3: On the basis of the mean values of each attribute, potential genotypes were found.

S. No.	Characters	Genotypes
1	Plant height(cm)	OS-403,HJ-8,RO-19,NDO-2, OL-14, JHO-2010-1, etc.
2	Tillers per plant	PS-7, OL-1869-1/OL-13,OS-403, HO-851, OS-377,,
3	Leaves per plant	UPO-94, RO-19, OL-14, OL-1760/OL-11, OL-10,
4	Leaf length(cm)	HJ-8,NDO-711, OL-1804, OS-377, PLP-1,
5	Leaf width(cm)	HJ-8,NDO-711, OL-1804, OS-377, PLP-1,
6	Fresh weight (g)	OS-403, HJ-8, NDO-711, RO-19, OL-804,
7	Leaf area(cm2)	HJ-8, NDO-711, OS-377, PLP-1, RO-19,OL-14,
8	Leaf area index	HJ-8, NDO-711, OS-377, PLP-1, RO-19, OL-14,
9	Dry weight (g.)	OL-424,OL-1902-1/OL-12,OS-403,NDO-10,
10	Harvest index (g)	NDO-2.
11	Days of 50% flowering	OL-1869-1/OL-13,OL-1769-1,NDO-711,OL-1804,
12	Grain weight (g)	OS-424,OS-403,OL-1804,RO-19,OL-10,OS-346.

Conclusion

On the basis of mean performance, genotypes OS-403, HJ-8, NDO-711, RO-19, OL-804, OS-377,RO-19,OL-14,OL-1760/OL-11,OL-10,CSAOFC-14-4, JHO-2010-1, NDO-10, UPO-212, OL-1802, OL-1876-2, UPO-06-1, OS-405, RO-11-1,OS-346.were found superior for fresh fodder yield compared to the best checks (KENT and OS-6) and OS-424,OS-403,OL-1804,RO-19,OL-10,OS-346 for grain yield per plant as compared to the best checks (KENT). High PCV along with high GCV was observed for Plant Height(cm), Tillers per Plant, Leaf per Plant, Leaf Length (cm),Leaf Width(cm), Fresh Weight (g), Leaf Area(cm2), Leaf Area Index, Dry Weight (g.),Harvest index (g), Grain Weight (g).High heritability coupled with high genetic advance was observed for plant height, leaf area (cm^2), fresh weight. So study revealed that plant height, leaf area (cm^2), fresh weight are trait can be used as parameter in breeding prorgamme for oat improvement.

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