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Assessment of oat (*Avena sativa* L.) genotypes for variation in seed vigour parameters under normal sown condition

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Abstract
The present study was carried out at coordinated Livestock Farm, All India Coordinated Research Project on Forage Crop (AICRP), Department of Agronomy, JNKVV, Jabalpur (M.P.) during year 2020-2021 to study the assessment of oat (*Avena sativa* L.) genotypes for variation in seed vigour parameters under normal sown condition. The research evaluated performance of thirty genotypes and laid out in randomized block design (RBD) with three replications. Data revealed that seed vigour parameters *viz*., seed germination (%), root length (cm), shoot length (cm), root: shoot ratio, vigour index-I and vigour index-II were maximum with in G_{18}: JMO-316, G_{27}: JMO-42 and G_{19}: JMO-317 genotypes. Seed vigour is directly correlation with the yield capacity. It showed that performance of seed quality.

Keywords: Oat, genotypes, seed vigour parameters, etc.

Introduction
Oat is the most significant cereal crop grown for grain and forage purpose in winter in north western and central states of India. Oat is called a multipurpose crop as it is used for staple food directly for human intake and indirectly for livestock feed (Varma *et al.* 2016) [11]. The oats farming in our country is widely done in Punjab and Haryana. The estimated area covered under oat cultivation in the country is about 500,000 ha. The major area under oat cultivation is in Uttar Pradesh (34%) followed by Punjab (20%), Bihar (16%), Haryana (9%) and Madhya Pradesh (6%) states of India.

Seed is the crucial input and most crucial components for enhancing the production and productivity of fodder crops. One of the reasons stated to stumble the green fodder production is non-availability of quality seed in sufficient quantities. As per an estimation only 25-30% of required quantity of quality seed is available in cultivated fodders and <10% in range fodder and legumes in India (Vijay *et al*., 2014) [12]. High quality seeds may increase crop yield via high and rapid emergence of seedlings, leading to the production of vigorous plants and optimum stand establishment under a wide range of environments (Ghassemi-Golezani *et al*., 2011) [5]. Therefore, cultivation of high quality seeds is important for satisfactory yield production. Several reports have revealed poor stand establishment caused by low seed quality and consequently yield loss in corn (Cruz-Garcia *et al*., 1995) [3].

The assessment of seed vigour is a vital component of seed quality and satisfactory levels are necessary in addition to traditional quality criteria of moisture, purity, germination and seed health to obtain optimum plant stand and high production of crops. Seeds seen to be low in Vigour will produce weaker seedlings that will be more susceptible to attack, contamination, and other environmental issues. Vigour is the first component of seed quality, loss of which is followed by a loss of germination capacity and viability (Trawatha *et al*., 1995) [10].

It takes well established plants that germinate quickly, evenly, and provide the maximum amount of healthy produce. The more vigorous the seed, Crop performance: Good, uniform crop stands. Seeds that are of uniform size, shape, colour, purity and cleanliness will produce stronger seedlings that become healthy plants.

The evaluation of germination and the identification of seed lots of high performance is an important initiative towards successful crop production, and consequently information from seed laboratories must accurately detect differences in physiological potential among tested seed lots.

The performance of seeds after sowing or during storage demonstrates whether the potential recognized by appropriate laboratory tests was achieved and how adequate were the procedures used to this estimation. The availability of good quality seed of forage crops in enough quantity is one of the major limitations, though improved varieties of various fodder crops have to be developed with the agro techniques have it be improved to secure the high yield potential of oat seed and fodder production and productivity in India.

Materials and Methods

The present research was conducted during the *Rabi* season of 2020-21 at laboratory of the Department of Plant Physiology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India, Jabalpur is located on north-central India of Madhya Pradesh located between 23.90^0 North latitude and 79.58^0 East longitudes. It altitude is 411.78 meter above mean sea level. The climate of region which is featured by hot dry summer and cool dry winters. Observations were recorded for laboratory conditions were seed germination (%), root length (cm), shoot length (cm), root: shoot ratio, vigour index-I and vigour index-II.

Germination (%)

100 seeds replicated thrice in each treatment in each replication were placed in between papers method (B.P.) and kept at 25 ºC in seed germinator. The seedlings were evaluated on the day of final count (10th day) and normal seedlings were considered for percent germination according to the rules of International Seed Testing Association (ISTA) 2016.

$$\text{Germination (\%)} = \frac{\text{Number of germinating seed}}{\text{Number of seed}} \times 100$$

Root length (cm)

Randomly five plants from each replication are selected to measure the length of root of seedling. The length of root is measured from the base up to the tip with the help of centimeter scale after 10 days.

Shoot length (cm)

Randomly five plants from each replication are selected to measure the length of shoot of seedling. The length of shoot is measured from the tip up to the base with the help of centimeter scale after 10 days.

Root: shoot ratio

The root and shoot ratio was determined after drying the roots and shoots in an electric oven at 80^0c for two or more days till constant weight was recorded.

Vigour index-I

Seedling vigour index was computed by adopting the formula as suggested by Abdul-Baki and Anderson (1973) [1] and expressed as an index number.

Vigour Index-I = (Root length (cm) + Shoot length (cm)) ×Germination percentage

6) Vigour index-II

Seedling vigour index was computed by adopting the formula as suggested by Abdul-Baki and Anderson (1973) [1] and expressed as an index number.

Vigour Index-II = Seedling dry weight (g) × Germination percentage

Results and Discussion

1. **Seed germination (%):** Seed germination is considered as one of the most critical stages for successful seedling establishment, efficient plant growth and development. Successful germination depends upon a number of factors that include the moisture content of the seeds, and growth conditions such as humidity as well as temperature (Finch-Savage and Bassel, 2016; Selvi and Saraswathy, 2017) [4, 9]. The results stated that genotype G_{27}: JMO-42 (94.21%) influenced significant maximum germination percentage G_{18}: JMO-316 (94.13%), G_{19}: JMO-317 (92.89%), G_{16}: JMO-303 (92.55%) and G_7: JMO-239 (92.33%) which were at par. Genotype G_{20}: Kent (check) (84.06%) and G_{28}: MJO15-1(84.34%) registered the minimum.
2. **Root length (cm):** The healthy plants with well-developed root systems can better withstand adverse conditions and a vigorous early seedling growth has been shown to be associated with higher yields (Harris *et al*., 2000) [6]. In vascular plants, the roots are the organs of a plant that are modified to provide anchorage for the plant and take in water and nutrients into the plant body, which allows plants to grow taller and faster (Harley Macdonald *et al*., 2019). The results noted that genotypes G_{18}: JMO-316 (25.57 cm), G_{19}: JMO-316 (25.48 cm) and G_{27}: JMO-42 (25.18 cm) possessed that the higher root length. On the other hand genotype G_{20}: Kent (check) (15.37 cm) had the lowest magnitudes for this trait.
3. **Shoot length (cm):** The new growth from seed germination that grows upward is a shoot where leaves will develop. The genotypes exhibited wide range of variability for shoot length ranging from 15.37 cm to 25.57 cm. The results revealed that genotype G_{18}: JMO-316 (25.57 cm) possessed the maximum shoot length though was at par with G_{19}: JMO-317 (25.48 cm) and G_{27}: JMO-42 (25.18 cm). Genotype G_{20}: Kent (check) (15.37 cm) recorded the minimum shoot length.
4. **Root: shoot ratio:** It's important because the root system plays a fundamental role in taking water and nutrients, and as the absorption at root level is more intense, the higher the biomass, hence the agricultural yield. The increase in dry matter root/shoot ratio implies the development of a larger ratio of root length density to leaf area, which translates into a better capacity for sustaining plant water status under a given evapo-transpiration demand (Blum and Arkin 1984) [2]. The genotype G_{10}: JMO-261 resulted (0.530) the significant highest root: shoot ratio followed by G_8: JMO-240 (0.523), G_{16}: JMO-303 (0.515), G7: JMO-239 (0.510), G18: JMO-316 (0.509) and G27: JMO-42 (0.504). The significant lowest root: shoot ratio (0.287) value was recorded in G_{20}: Kent (check).
5. **Vigour index I:** Vigour is a qualitative term encompassing the sum total of those properties of the seed that determine the potential level of activity and performance of the seed during germination and seedling emergence in a wide range of environment (ISTA. 2015). The results shown the significant highest vigour index I for the genotype G_{27}: JMO-42 (4517.24) followed by G_{19}: JMO-317 (4487.70) and G_{18}: JMO-316

(4466.69). The significant lowest vigour index I (2413.64) value was recorded in G_{29}: MJO15-3.

6. **Vigour index II:** The seedling vigour index-II is a parameter related to weight of the seedlings. Seed vigour index-mass is another significant parameter which determines the performance of seeds in fields conditions which is attributed to seedling dry weight and germination. There was significant variation in seedling vigour index-II across the thirty genotypes ranging from 8.961 to 17.549**.**The results expressed that the genotypes G_{18}: JMO-316 (17.549) had the maximum vigour index II at par with G_{16}: JMO-303 (17.267), G_{27}: JMO-42 (17.207) and G_{19}: JMO-317 (17.005). The significant minimum vigour index II (8.961) value was recorded in G_{20}: Kent (check).

Table 1: A various seed vigour parameters of Rabi oat genotypes during year 2020- 2021

Genotypes	Germination (%)	Root length (cm)	Shoot length (cm)	Root: Shoot ratio	Vigour index I	Vigour index II
G_1: JO-1(check)	85.56	14.20	16.29	0.445	2609.37	13.376
G_2: JMO-207	86.67	19.78	18.18	0.388	3290.69	12.086
G_3: JMO-214	87.54	14.03	16.22	0.382	2648.20	11.667
G_4: JMO-215	88.31	17.93	18.65	0.400	3230.19	12.412
G_5: JMO-217	88.80	18.68	21.14	0.373	3535.77	11.658
G_6: JMO-234	89.78	16.08	22.20	0.397	3445.55	12.448
G_7: JMO-239	92.33	21.81	23.03	0.510	4152.10	17.222
G_8 : JMO-240	86.43	15.03	18.25	0.523	2877.09	16.572
G_9: JMO-257	87.78	20.11	21.96	0.475	3698.94	14.857
G_{10}: JMO-261	91.13	22.02	23.45	0.530	4143.17	17.910
G_{11}: JMO-263	85.92	15.04	17.45	0.401	2799.09	12.022
G_{12}: JMO-264	90.32	15.77	18.92	0.485	3136.32	15.468
G_{13}: JMO-270	87.85	19.01	22.40	0.388	3638.53	12.236
G_{14}: JMO-271	86.14	14.95	15.81	0.425	2649.51	12.765
G_{15}: JMO-272	86.03	21.60	22.08	0.452	3764.93	13.671
G_{16}: JMO-303	92.55	21.97	24.19	0.515	4271.45	17.267
G_{17}: JMO-304	86.39	13.40	20.17	0.418	2909.38	12.634
G_{18}: JMO-316	94.13	21.89	25.57	0.509	4466.69	17.549
G_{19}: JMO-317	92.89	22.48	25.48	0.502	4487.70	17.005
G_{20}: Kent (check)	84.06	12.23	15.37	0.287	2319.48	8.961
G_{21}: JMO-401	85.98	21.07	22.05	0.414	3745.97	12.469
G_{22}: JMO-407	87.43	22.13	24.70	0.492	4094.14	15.578
G_{23}: JMO-422	89.96	17.77	21.81	0.456	3564.42	14.461
G_{24}: JMO-209	87.44	17.92	21.27	0.450	3426.21	13.859
G_{25}: JMO-211	88.09	22.61	16.92	0.447	3457.73	13.830
G_{26}: JMO-46	90.30	22.35	21.70	0.449	3990.76	14.261
G_{27}: JMO-42	94.21	22.78	25.18	0.504	4517.24	17.207
G_{28}: MJO15-1	84.34	11.95	16.60	0.334	2413.64	10.061
G_{29}: MJO15-3	85.08	13.42	16.79	0.444	2569.22	13.065
G_{30}: MJO15-5	85.42	14.77	16.54	0.388	2674.54	11.555
Mean	88.30	18.16	20.35	0.439	3417.60	13.871
S.Em±	2.14141	0.62476	1.04859	0.02170	113.0714	0.66440
CD at 5%	6.06203	1.76862	2.96840	0.06143	320.0891	1.88082

Conclusion

The ability of seeds to quickly germinate was one of the early attributes of seed vigor and became an important indicator of seed physiological quality as a more sensitive index of seed performance than germination percentage. Studies on major seed vigour parameters revealed that seed germination (%), root length (cm), shoot length (cm), root: shoot ratio, vigour index-I, vigour index-II were significantly superior under G_{18}: JMO-316 genotypes, followed by G_{27}: JMO-42, G_{19}: JMO-317 genotypes while minimum recorded in G20: Kent (check).

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