# Genetic divergence and Cluster Studies for Different Morphological traits in bread Wheat

## Abstract

A field experiment was conducted on 135 wheat genotype under timely sown condition, in order to determine the genetic variability and genetic diversity. The experimental findings indicated highly significant differences in genotypes for all 12 morphological traits taken under study. Clustering of genotypes revealed that Cluster VI had highest genotypes followed by cluster VIII, V, II , III. The lowest genotypes were noted in cluster I. The average inter cluster $D^2$ values indicated that the most diverse groups were V and IV followed by cluster IV and I, VI and I. The lowest inter cluster value was found among VIII and V. The genotypes bearing desired values from different clusters can be exploited in future breeding programme for improving the yield and physiological traits.

**Keywords:** Genetic diversity, Grain yield and Clustering.

## Introduction

Wheat (*Triticum aestivum* L.) is an important cereal crop of the family Graminae (Poaceae), the largest family within the monocots. It is an allohexaploid with chromosome number 42 (2n = 6x = 42) comprising three genetically related genomes A, B, and D (Sears,1969). Wheat originated in the Ethiopian highlands and the Levant region of the Near East, although it is now grown all over the world. A substantial percentage of many people's daily dietary energy comes from wheat.

Wheat contains proteins, essential minerals, lipids and vitamins. Nutritional content of wheat is comparable to that of other cereals. It provides on an average of 70% of total carbohydrate, 59.2 % starch, 12.61 % protein, 2.54% lipids. It also provides vitamins and minerals such as calcium, (37 mg per 100 gm0 and riboflavin (0.13 mg per 100 gm) (Lorenz and kulp 1991) on of wheat worldwide in 2021–2022 was 779 million metric tons. According to https://wheat.org/wheat-in-the-world/, it is consumed by around 2.5 billion people in 89 countries and makes up 20% of all the calories in a person's diet. With a production of 103.86 million metric tons in 2021–2022, India is the world's second-largest producer of wheat, surpassing the average production of 103.88 million tonnes over the previous five years by 2.96 million tonnes (IIWBR, Annual report, 22–23). Wheat offers the greatest genetic diversity, which allows desired genes to hybridize and recombine to create new potential genotypes with broader adaption. Increased grain yield of wheat crop is main concern of wheat breeders; they have been utilizing the available genetic resources to change the existing varieties and evolving new crop varieties to meet the ever-changing requirements of the societies. Therefore, the present investigation was undertaken to study the **"**Genetic divergence and Cluster Studies for Different morphological traits in bread Wheat" under normal sown condition, using the genetic material available in the department of Genetics and Plant Breeding, ANDUAT, Kumarganj, Ayodhya.

## Materials and Methods

The study was conducted at Acharya Narendra Deva University of Agriculture and Technology, Ayodhya, U.P during the Rabi season of 2021-22 under timely sown condition. A total of 135 genotypes were grown in an Augmented block design with four checks in a single row plot with a plot size of 23 x 10 cm and recommended agronomic practices were followed to raise the healthy crop. Observations were recorded on grain yield and its related traits, viz. days to flowering, days to maturity, plant height, spike length, flag leaf area, peduncle length, number of tillers per plant, number of seed per spike, 1000 seed weight, biological yield per plant, harvest index and grain yield per plant. The data was analysed using OPSTAT (software available at http: //www.hau.ernet.in.), INDOSTAT (version 8.0), SPSS (version 24.0), STAR (Statistical Tool for Agricultural Research) software and The evaluation of genetic divergence of 135 wheat genotypes was done with the help of non-hierarchical Euclidean cluster analysis statistics as mentioned by **(Beale, 1969;Spark, 1973).**

## Result and discussions

## Analysis of variance

The analysis of variance (ANOVA) for the augmented block design obtained for 135 genotypes along with four checks for all 12 characters and presented **(Table 1).**The variance analysis indicated the presence of adequate variability. The perusal of table revealed high significant difference among the treatments for all characters. The variation due to checks were highly significant for all the traits.

## Cluster information

Under present study, The 135 genotypes were grouped into eight clusters **(Table 2).** Cluster VI had highest genotypes i.e., 32 followed by cluster VIII with 24 genotypes ,cluster V with 22 genotypes, cluster second with 15 genotypes and cluster III with 12 genotypes. The lowest genotypes were noted in cluster I having 5 genotypes suggesting considerable amount of genetic diversity prsesent in the material.

## Cluster mean for 12 characters in wheat

The lowest cluster mean was observed for Days to 50 % Flowering in cluster I (73.80) **(Table 3)** whereas, highest cluster mean for cluster VI (80.74) followed by cluster II (78.93). The highest cluster mean for plant height was recorded for cluster VIII (88.26) followed by cluster VII (88.13), Cluster IV (87.72) and lowest cluster mean showed by cluster I (74.52). The genotype of cluster VIII (130.33) has shown highest value for Days to Maturity followed by cluster VII (129.93) on the other hand, lowest value of cluster mean shown by cluster III (111.67). Cluster VI (11.90) showed highest cluster mean for Spike length followed by cluster V (11.41), cluster II (11.39) whereas , lowest cluster mean was observed in cluster I (7.36). The genotype of cluster IV (23.89) so highest value for Panicle Length followed by cluster III (23.50) on the other hand lowest value of cluster mean showed by cluster VIII (18.63). The genotype of cluster IV (26.09) has shown Highest Value for Flag Leaf Area followed by cluster III (24.54) on the other hand lowest value of cluster mean showed by cluster I (20.38). Cluster mean of number of grain per spike was recorded highest in cluster IV (62.11) followed by cluster III(55.31) and lowest in cluster II (45.21). The lowest cluster mean was observed for no. of productive tillers/plant for cluster V (5.05) whereas highest cluster mean for cluster VII(8.11) followed by cluster IV (7.50) , cluster III (7.14) . The genotype of cluster VII (41.61) has showed highest value for 1000-Grain Weight followed by cluster III (40.85) on the other hand lowest value of cluster mean showed by cluster I (36.22). The genotype of cluster VII (37.56) showed highest value for Biological yield/Plant followed by cluster IV (40.85), Cluster VI (40.72) on the other hand lowest value of cluster mean showed by cluster VIII (29.43). Cluster mean of harvest index was recorded highest in cluster IV(48.02) and cluster III (44.23), followed by Cluster VIII (43.95) and lowest in cluster VII(37.02). The genotype of cluster IV (17.47) has showed highest value of Grain Yield/Plant followed by cluster III (14.52). On the other hand lowest value of cluster mean showed by cluster V (11.75). Similar results of genetic diversity were also recorded Arya et al. (2017), Chaudhary *et al*.(2022) and Wani *et al* .(2018).

## Inter and Intra cluster distance

The average intra and inter - cluster distance between different clusters is given **(Table4).** The intra - cluster $D^2$ values ranged from 2.262 (cluster I) to 2.691 (cluster IV). The average inter cluster $D^2$ values indicated that the most diverse groups were V and IV (5.374) followed by cluster IV and I (5.354), VI and I (5.065). The lowest inter cluster value was found among VIII and V (2.174) indicate that this group is less diverse.

## Conclusion

All genotypes differed significantly among themselves for all 12 characters studied. The variances due to checks were highly significant for all the traits. The 135 genotypes were grouped into eight distinct clusters. The 135 genotypes were grouped into eight clusters. Cluster VI had highest genotypes (32) followed by cluster VIII, V ,II,III. The lowest genotypes were noted in cluster I. The average inter cluster $D^2$ values indicated that the most diverse groups were V and IV followed by cluster IV and I, VI and I. The lowest inter cluster value was found among VIII and V. The genotype of cluster IV (17.47) has showed highest value of Grain Yield/Plant followed by cluster III (14.52). On the other hand , lowest value of cluster mean showed by cluster V.

## References

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**Table 1: ANOVA of Augmented Block Design for 12 characters in wheat**

| Source of variation | DF | Days to 50% flowering | Plant height (cm) | Days to maturity | Spike length (cm) | Peduncle length (cm) | Flag leaf area (cm $^2$) | No. of grains per spike | No.of Tillers per plant | 1000 seed weight (gm) | Biological yield per plant (gm) | Harvest index | Grain yield per plant (gm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Block** | 8 | 68.79** | 165.73** | 594.62** | 5.26** | 175.18** | 23.49** | 167.87** | 6.24** | 27.00** | 41.73** | 69.94** | 18.65** |
| **TREAT** | 138 | 49.92** | 61.03** | 18.40** | 3.18** | 29.30** | 10.35** | 57.11** | 1.08** | 6.62** | 17.82** | 18.20** | 3.27** |
| **CHECKS** | 3 | 26.32** | 545.52** | 18.99** | 12.66** | 5.50** | 7.81** | 39.45** | 2.45** | 21.50** | 51.85** | 39.81** | 3.87** |
| **ERROR** | 24 | 3.72 | 21.82 | 2.99 | 1.24 | 4.33 | 5.74 | 9.98 | 0.47 | 2.52 | 0.33 | 4.34 | 0.40 |
| **TOTAL** | 170 | 44.28 | 60.42 | 43.34 | 3.07 | 32.64 | 10.32 | 55.67 | 1.26 | 7.00 | 16.48 | 18.68 | 3.59 |

*, ** significant at 5% and 1% level, respectivel

**Table 2 :** **Number of genotypes in each cluster**

| Clusters | No of genotypes | Genotypes |
|---|---|---|
| **I** | 5 | 100 101 102 103 110 |
| **II** | 15 | 5 93 94 95 96 97 98 99 104 105 106 107 108 109 **130** |
| **III** | 12 | **114 115 117 118 119 121 123 127 128 129 132 133** |
| **IV** | 14 | 74 91 **111 112 113 116 120 122 124 125 126 131 134 135** |
| **V** | 22 | 29 30 31 33 34 36 37 38 40 42 43 44 46 47 48 49 50 51 52 53 58 89 |
| **vi** | 32 | 1 2 3 4 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 41 87 136 137 138 139 |
| **Vii** | 15 | 54 59 60 62 64 66 67 69 72 73 75 76 81 90 92 |
| **viii** | 24 | 28 32 35 39 45 55 56 57 61 63 65 68 70 71 77 78 79 80 82 83 84 85 86 88 |

## Table 3 :Cluster mean for twelve characters in wheat

| Clusters | | Days to flowerig | Plant height (cm) | Days to maturity | Spike length | Peduncle length(cm) | Flag leaf area (cm²) | No. of seed per spike | No. of tillers per plant | 1000 seed weight (g) | Biological yield per plant (g) | Harvest index (%)) | Grain yield per plant (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **I** | **Mean** | 73.80 | 74.52 | 120.00 | 7.36 | 20.41 | 20.38 | 46.53 | 5.84 | 36.22 | 34.76 | 39.61 | 13.76 |
| | **SE±** | 3.63 | 5.78 | 2.92 | 1.82 | 2.07 | 1.47 | 4.12 | 0.62 | 2.52 | 3.04 | 0.42 | 1.08 |
| **II** | **Mean** | 78.93 | 77.34 | 115.53 | 11.39 | 20.44 | 23.09 | 45.21 | 6.41 | 37.32 | 31.09 | 40.20 | 12.50 |
| | **SE±** | 2.71 | 4.14 | 5.54 | 1.78 | 2.34 | 1.52 | 4.91 | 0.74 | 2.62 | 3.44 | 1.26 | 1.41 |
| **III** | **Mean** | 74.50 | 83.24 | 111.67 | 10.07 | 23.50 | 24.54 | 55.31 | 7.14 | 40.85 | 32.88 | 44.23 | 14.52 |
| | **SE±** | 2.75 | 8.75 | 3.37 | 1.46 | 1.93 | 3.58 | 6.13 | 0.80 | 2.09 | 2.00 | 2.40 | 0.91 |
| **IV** | **Mean** | 77.86 | 87.72 | 116.43 | 10.16 | 23.89 | 26.09 | 62.11 | 7.50 | 40.41 | 36.60 | 48.02 | 17.47 |
| | **SE±** | 2.68 | 7.34 | 5.33 | 1.12 | 3.72 | 3.45 | 4.86 | 0.52 | 2.21 | 4.11 | 3.37 | 1.23 |
| **V** | **Mean** | 78.23 | 83.05 | 128.14 | 11.41 | 19.70 | 22.02 | 50.84 | 5.05 | 36.77 | 30.58 | 38.73 | 11.75 |
| | **SE±** | 1.88 | 5.11 | 2.27 | 1.08 | 3.17 | 2.58 | 5.94 | 0.52 | 2.03 | 3.31 | 3.62 | 0.84 |
| **VI** | **Mean** | 80.74 | 81.20 | 125.80 | 11.90 | 29.99 | 23.83 | 50.02 | 6.06 | 40.72 | 30.21 | 42.55 | 12.82 |
| | **SE±** | 2.03 | 5.04 | 2.10 | 1.10 | 1.68 | 3.83 | 4.89 | 0.63 | 1.83 | 3.51 | 3.71 | 1.68 |
| **VII** | **Mean** | 78.27 | 88.13 | 129.93 | 10.90 | 18.96 | 23.13 | 54.29 | 8.11 | 41.60 | 37.56 | 37.02 | 13.81 |
| | **SE±** | 1.79 | 6.27 | 2.52 | 1.21 | 2.74 | 2.94 | 7.71 | 0.49 | 1.88 | 3.55 | 4.46 | 1.29 |
| **VIII** | **Mean** | 77.58 | 88.26 | 130.33 | 11.04 | 18.63 | 23.72 | 54.32 | 5.84 | 39.77 | 29.43 | 43.95 | 12.91 |
| | **SE±** | 2.47 | 6.75 | 2.37 | 0.76 | 2.00 | 2.56 | 7.15 | 0.95 | 2.42 | 3.40 | 2.50 | 1.49 |

**Table 4: Inter and intra distances**

| Clusters | I | II | III | IV | V | VI | VII | VIII |
|---|---|---|---|---|---|---|---|---|
| **I** | **2.262** | | | | | | | |
| **II** | 3.604 | **2.475** | | | | | | |
| **III** | 3.893 | 3.240 | **2.601** | | | | | |
| **IV** | 5.354 | 4.731 | 2.623 | **2.691** | | | | |
| **V** | 3.903 | 2.485 | 4.283 | 5.374 | **2.269** | | | |
| **VI** | 5.065 | 2.986 | 3.772 | 4.467 | 3.071 | **2.478** | | |
| **VII** | 4.875 | 3.969 | 3.814 | 4.077 | 3.864 | 3.946 | **2.533** | |
| **VIII** | 4.469 | 3.234 | 3.523 | 4.184 | 2.174 | 2.938 | 3.246 | **2.518** |