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# Selection and Precis(e) Varietal Recommender System

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*Keywords:* *crop ideotypes, normalized cumulative ranks, recommender system, selection.*

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*Strictly as per the compliance and regulations of:*

# Selection and Precis(e) Varietal Recommender System

Rajnish Singh [α] & Shri Niwas Singh [σ]

*Abstract-* A field experiment in a randomized block design was conducted during Rabi season 2019-2020 on 13 wheat varieties with the twin objectives of objectively selecting and precisely recommending the suitable plant types to farmers of Deoria district in eastern Uttar Pradesh. The varieties were evaluated on 12 characters like plant height (cm), flag leaf area ($cm^2$), peduncle length (cm), spike length (cm), effective tillers, grains per spike (grain number), grain weight (g), spikelets per spike, test weight (g), grain yield per plant (g), biological yield per plant (g) and harvest index (%). Normalized cumulative ranks were used to objectively select suitable crop ideotypes. The top five varieties *viz.*, HD-2967, MACS-6222, HUW-669, K-0307 and HUW-213 were precisely recommended to farmers of this region for cultivation.

*Keywords: crop ideotypes, normalized cumulative ranks, recommender system, selection.*

## I. Introduction

Wheat is a very staple food crop of billions of people world-wide. However, its production is hampered by non-availability of suitable varieties and local limiting factors. Variety plays an important role and selection of suitable wheat variety is crucial as per local conditions of farmers' fields. That is why an experiment was designed and conducted to evaluate thirteen wheat varieties under the conditions of farmland of B. R. D. P. G. College, Deoria, in eastern Uttar Pradesh, India. The twin objectives of this experiment were to: 1. provide a very objective variety selection procedure and based on this selection, 2. develop a very precise varietal recommender system so that farmers of this region get the best varieties suitable to their field conditions.

## II. Materials and Methods

The field experiment under present investigation was conducted during Rabi 2019-2020 at Agricultural Research Farm of Baba Raghav Das Post Graduate College, Deoria in eastern Uttar Pradesh, India. Geographically, this College is located in the eastern part of Uttar Pradesh, India. The site of experiment is located at 26.5°N latitude, 83.79°E longitude and 68 meters (223 feet) above mean sea level. The climate of district is semi-arid with hot summer and cold winter. Nearly 80% of total rainfall is received during monsoon (only up to September) with a few winter- and pre-monsoon showers.

The experimental materials comprised of 13 wheat genotypes available in wheat section of the department of Genetics and Plant Breeding, BRD PG College, Deoria (U.P.). The varieties included are HD-2967, HD-3086, HUW-213, HUW-37, HUW-510, HUW-669, K-0307, MACS-6222, MAYHYCO- GOAL, PBW-343, SHREERAM-303, UP-2672 and WB-2. The experiment was conducted in a randomized block design comprising of thirteen treatments and three replications. The data were recorded on 12 characters including plant height (cm), flag leaf area ($cm^2$), peduncle length (cm), spike length (cm), effective tillers, grains per spike (grain number), grain weight (g), spikelets per spike, test weight (g), grain yield per plant (g), biological yield per plant (g) and harvest index (%).

## III. Data Analysis

The experimental data were collected on 12 parameters of thirteen wheat genotypes. These data were compiled by taking the mean values (Table 1) of five selected plants in each plot and subjected to following non-parametric analysis:

## IV. Ranking, Normalizing and Calculating Normalized Cumulative Ranks

An example of a nonparametric statistical analysis procedure is given here to comprehend a small data-set of wheat-diversity for wheat breeding. Thirteen wheat genotypes in three replications were evaluated on twelve parameters. The proposed normalized cumulative ranks considered all the twelve parameters and gave an ordered list of genotypes. Each parameter was given due consideration and a normalized cumulative rank for each genotype was calculated. The cumulative ranks could be normalized in any desired way either by minimum, maximum (directional selection) or mid values (stabilizing selection). In this case the cumulative ranks were normalized by minimum. The parameters needing further attention for the improvement in desired genotypes were identified.

The procedure was carried out in two steps: 1. Calculation of ranks of each genotype and summing the ranks to find cumulative rank, and 2. Normalizing the cumulative ranks by minimum value and finding out a

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preferred list of genotypes by sorting the normalized cumulative ranks. The two steps could be easily understood by the following two formulae: 1. CR $= \sum_{i=1}^{n} R_i$ and 2. NCR = CR/CR$_{min}$, where, CR = cumulative rank; NCR = normalized cumulative rank; R = Rank; n = number of parameters (or characters) evaluated. The values of NCR would range from one to CR/CR$_{min}$. NCR value one (1) would show the best genotype and the maximum value would show the worst genotype. The range would be an indicator of diversity. A single line formula for normalized cumulative ranks (NCR) analysis could be given as $NCR = (\sum_{i=1}^{n} R_i)/(\sum_{i=1}^{n} R_i)min.$

*Table 1:* Average values based on the three replications

| S. NO | GENOTYPES ↓ | Plant height (cm) | Flag leaf area (cm2 ) | Peduncle length (cm ) | Spike length / plant (cm ) | No. Of productive tillers | Grain no | Grain weight (g) | Spikelets | Test weight (g) | Grain yield (g/plant) | Biological yield (g/plant) | Harvest index (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sort Order→ | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | HD - 2967 | 92.27 | 31.11 | 44.45 | 12.31 | 7.2 | 43.4 | 2.2 | 21.67 | 47.73 | 11.93 | 35.33 | 33.51 |
| 2 | HD - 3086 | 91.6 | 31.27 | 46.38 | 9.66 | 6.8 | 49.4 | 2 | 16.93 | 36.13 | 10.07 | 27.53 | 37.01 |
| 3 | HUW - 213 | 97.57 | 41.91 | 50.71 | 9.86 | 7.87 | 59.67 | 2.13 | 19.07 | 38.33 | 11.33 | 32.67 | 34.79 |
| 4 | HUW - 37 | 89.41 | 40.79 | 45.29 | 10.47 | 6.33 | 44.13 | 1.73 | 16.4 | 40.87 | 10.6 | 33.13 | 32.07 |
| 5 | HUW - 510 | 85.75 | 41.86 | 46.08 | 10.33 | 7.67 | 43.2 | 1.87 | 16.4 | 42.33 | 11.27 | 33.33 | 34 |
| 6 | HUW - 669 | 90.87 | 38.19 | 43.81 | 11.06 | 6.47 | 55.73 | 2.2 | 19.73 | 41.13 | 12.2 | 32.2 | 38.42 |
| 7 | K - 0307 | 90.99 | 33.33 | 46.2 | 11.26 | 6.4 | 52.4 | 2 | 19 | 39.2 | 12 | 30.73 | 39 |
| 8 | MACS - 6222 | 90.87 | 37.45 | 44.87 | 10.7 | 7.4 | 63.07 | 2.33 | 19.67 | 39.67 | 12.53 | 32.4 | 38.52 |
| 9 | MAHYCO GOAL | 89.29 | 34.32 | 45 | 11.65 | 5.8 | 49.07 | 2 | 18.87 | 40.47 | 9.93 | 27.53 | 35.34 |
| 10 | PBW - 343 | 82.33 | 32.18 | 36.67 | 9.37 | 6.4 | 35.53 | 1.93 | 16.6 | 44.6 | 8.73 | 21.4 | 42.96 |
| 11 | SHREE RAM - 303 | 84.49 | 33.37 | 42.35 | 11.39 | 5.53 | 46.8 | 2.07 | 19.33 | 42.8 | 9.07 | 23.93 | 39.56 |
| 12 | UP - 2672 | 89.85 | 38.97 | 45.71 | 10.4 | 7.47 | 45.07 | 2.27 | 17.93 | 43 | 10.27 | 31.8 | 33.63 |
| 13 | WB - 2 | 88.11 | 26.28 | 39.55 | 10.07 | 6.27 | 57.53 | 2.27 | 20.53 | 38.2 | 11.53 | 28.53 | 39.22 |

*(0 = Descending, 1 = Ascending)*

From sort order as given in table 1, it is clear that desirable plant types being selected are for tall plants, less flag leaf area, more peduncle length, and remaining all characters for more.

## V. Results and Discussion

The results of the analysis are given in table 2.

*Table 2:* Ranks, CR and NCR values that give Table 3 on sorting on CR or NCR.

| S. NO | GENOTYPES ↓ | Plant height (cm) | Flag leaf area (cm2 ) | Peduncle length (cm ) | Spike length / plant (cm ) | No. Of productive tillers | Grain no | Grain weight (g) | Spikelets | Test weight (g) | Grain yield (g/plant) | Biological yield (g/plant) | Harvest index (%) | CR | NCR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sort Order→ | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 1 | HD - 2967 | 2 | 2 | 9 | 1 | 5 | 11 | 4 | 1 | 1 | 4 | 1 | 12 | 53 | 1 |
| 2 | HD - 3086 | 3 | 3 | 2 | 12 | 6 | 6 | 8 | 10 | 13 | 10 | 10 | 7 | 90 | 1.7 |
| 3 | HUW - 213 | 1 | 13 | 1 | 11 | 1 | 2 | 6 | 6 | 11 | 6 | 4 | 9 | 71 | 1.34 |
| 4 | HUW - 37 | 8 | 11 | 6 | 7 | 10 | 10 | 13 | 12 | 7 | 8 | 3 | 13 | 108 | 2.04 |
| 5 | HUW - 510 | 11 | 12 | 4 | 9 | 2 | 12 | 12 | 12 | 5 | 7 | 2 | 10 | 98 | 1.85 |
| 6 | HUW - 669 | 5 | 9 | 10 | 5 | 7 | 4 | 4 | 3 | 6 | 2 | 6 | 6 | 67 | 1.26 |
| 7 | K - 0307 | 4 | 5 | 3 | 4 | 8 | 5 | 8 | 7 | 10 | 3 | 8 | 4 | 69 | 1.3 |
| 8 | MACS - 6222 | 5 | 8 | 8 | 6 | 4 | 1 | 1 | 4 | 9 | 1 | 5 | 5 | 57 | 1.08 |
| 9 | MAHYCO GOAL | 9 | 7 | 7 | 2 | 12 | 7 | 8 | 8 | 8 | 11 | 10 | 8 | 97 | 1.83 |
| 10 | PBW - 343 | 13 | 4 | 13 | 13 | 8 | 13 | 11 | 11 | 2 | 13 | 13 | 1 | 115 | 2.17 |
| 11 | SHREE RAM - 303 | 12 | 6 | 11 | 3 | 13 | 8 | 7 | 5 | 4 | 12 | 12 | 2 | 95 | 1.79 |
| 12 | UP - 2672 | 7 | 10 | 5 | 8 | 3 | 9 | 2 | 9 | 3 | 9 | 7 | 11 | 83 | 1.57 |
| 13 | WB - 2 | 10 | 1 | 12 | 10 | 11 | 3 | 2 | 2 | 12 | 5 | 9 | 3 | 80 | 1.51 |

*Table 3:* Varietal preference order based on 12 parameters analyzed

| S. NO | GENOTYPES ↓ | Plant height (cm) | Flag leaf area (cm2 ) | Peduncle length (cm ) | Spike length / plant (cm ) | No. Of productive tillers | Grains/ ear | Grain weight (g) | Spikelets | Test weight (g) | Grain yield (g/plant) | Biological yield (g/plant) | Harvest index (%) | CR | NCR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sort Order→ | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 1 | HD - 2967 | 2 | 2 | 9 | 1 | 5 | 11 | 4 | 1 | 1 | 4 | 1 | 12 | 53 | 1 |
| 2 | MACS - 6222 | 5 | 8 | 8 | 6 | 4 | 1 | 1 | 4 | 9 | 1 | 5 | 5 | 57 | 1.08 |
| 3 | HUW - 669 | 5 | 9 | 10 | 5 | 7 | 4 | 4 | 3 | 6 | 2 | 6 | 6 | 67 | 1.26 |
| 4 | K - 0307 | 4 | 5 | 3 | 4 | 8 | 5 | 8 | 7 | 10 | 3 | 8 | 4 | 69 | 1.3 |
| 5 | HUW - 213 | 1 | 13 | 1 | 11 | 1 | 2 | 6 | 6 | 11 | 6 | 4 | 9 | 71 | 1.34 |
| 6 | WB - 2 | 10 | 1 | 12 | 10 | 11 | 3 | 2 | 2 | 12 | 5 | 9 | 3 | 80 | 1.51 |
| 7 | UP - 2672 | 7 | 10 | 5 | 8 | 3 | 9 | 2 | 9 | 3 | 9 | 7 | 11 | 83 | 1.57 |
| 8 | HD - 3086 | 3 | 3 | 2 | 12 | 6 | 6 | 8 | 10 | 13 | 10 | 10 | 7 | 90 | 1.7 |
| 9 | SHREE RAM - 303 | 12 | 6 | 11 | 3 | 13 | 8 | 7 | 5 | 4 | 12 | 12 | 2 | 95 | 1.79 |
| 10 | MAHYCO GOAL | 9 | 7 | 7 | 2 | 12 | 7 | 8 | 8 | 8 | 11 | 10 | 8 | 97 | 1.83 |
| 11 | HUW - 510 | 11 | 12 | 4 | 9 | 2 | 12 | 12 | 12 | 5 | 7 | 2 | 10 | 98 | 1.85 |
| 12 | HUW - 37 | 8 | 11 | 6 | 7 | 10 | 10 | 13 | 12 | 7 | 8 | 3 | 13 | 108 | 2.04 |
| 13 | PBW - 343 | 13 | 4 | 13 | 13 | 8 | 13 | 11 | 11 | 2 | 13 | 13 | 1 | 115 | 2.17 |

Based on the sorted NCR values, as shown in Table 3, the top five varieties *viz.*, HD-2967, MACS-6222, HUW-669, K-0307 and HUW-213 were recommended to farmers of this region for cultivation. In comparison to other varieties, PBW-343 is becoming obsolete and it is evident from table 3 also that its (PBW-343's) ranking is very low in 6 to 8 parameters (1st, 3rd, 4th, 6th, 10th and 11th parameters ranking all 13th and 7th and 8th parameters ranking 11th). Once this variety used to be very popular in this region and long back in a varietal trial (Gaur *et al.*, 2010) its performance was not good compared to other tested varieties. That is why, it was predicted that slowly PBW-343 will become an obsolete variety in this region. The most suitable variety (HD-2967) can be further improved by paying attention to parameters 3rd (peduncle length), 6th (grains/ear) and 12th (harvest index). In this small dataset, PBW-343 ranks first in harvest index. Hence, one may think of crossing PBW - 343 with overall top ranking HD-2967 for its further improvement. This way, if large datasets are created, we could get clues for what needs to be done for further improvement of a newly improved or popular variety. Similarly, grains per ear of HD - 2967could be improved further by crossing with HUW – 213. These ideas might give clues for how to go about gene pyramiding.

*a) Precis(e) varietal recommender system*

Quite often, due to shortage of time and resources, we have no option but to be very precis(e) in our presentation. This happens during paper presentations, poster presentations and paper writings. This problem comes while presenting the varietal screening data especially when a large number of varieties/ genotypes/ accessions are tried in multi-location trials. Under such a scenario, the raw data (e.g., Table 1) and the ranking data (Table 2) could be combined into a single table as given in Table 4. After sorting the table 4 on CR or NCR, we get Table 5. To be even more precis(e) than the above suggestions, we can give only one table (Table 5) to sum up whole findings. When the numbers of entries in the trials are large enough to present in a single page table, then only a single page could be presented showing only the top performers. This precis(e)ness saves paper, time and money. This experiment and the paper got inspiration from crop ideotype concept of Donald, C.M. (1968). Similar types of non-parametric analyses were carried out by Singh 2017, Singh *et. al.* 2018 and Yadav *et. al*. 2020.

*Table 4:* Precis(e) varietal recommendation: combining initial two tables

| S. No. | GENOTYPES ↓ | Plant height (cm) | Flag leaf area (cm2 ) | Peduncle length (cm ) | Spike length / plant (cm ) | No. Of productive tillers | Grain no | Grain weight (g) | Spikelets | Test weight (g) | Grain yield (g/plant) | Biological yield (g/plant) | Harvest index (%) | CR | NCR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sort Order→ | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 1 | HD - 2967 | 92.27 (2) | 31.11 (2) | 44.45 (9) | 12.31 (1) | 7.2 (5) | 43.4 (11) | 2.2 (4) | 21.67 (1) | 47.73 (1) | 11.93 (4) | 35.33 (1) | 33.51 (12) | 53 | 1 |
| 2 | HD - 3086 | 91.6 (3) | 31.27 (3) | 46.38 (2) | 9.66 (12) | 6.8 (6) | 49.4 (6) | 2 (8) | 16.93 (10) | 36.13 (13) | 10.07 (10) | 27.53 (10) | 37.01 (7) | 90 | 1.7 |
| 3 | HUW - 213 | 97.57 (1) | 41.91 (13) | 50.71 (1) | 9.86 (11) | 7.87 (1) | 59.67 (2) | 2.13 (6) | 19.07 (6) | 38.33 (11) | 11.33 (6) | 32.67 (4) | 34.79 (9) | 71 | 1.34 |
| 4 | HUW - 37 | 89.41 (8) | 40.79 (11) | 45.29 (6) | 10.47 (7) | 6.33 (10) | 44.13 (10) | 1.73 (13) | 16.4 (12) | 40.87 (7) | 10.6 (8) | 33.13 (3) | 32.07 (13) | 108 | 2.04 |
| 5 | HUW - 510 | 85.75 (11) | 41.86 (12) | 46.08 (4) | 10.33 (9) | 7.67 (2) | 43.2 (12) | 1.87 (12) | 16.4 (12) | 42.33 (5) | 11.27 (7) | 33.33 (2) | 34 (10) | 98 | 1.85 |
| 6 | HUW - 669 | 90.87 (5) | 38.19 (9) | 43.81 (10) | 11.06 (5) | 6.47 (7) | 55.73 (4) | 2.2 (4) | 19.73 (3) | 41.13 (6) | 12.2 (2) | 32.2 (6) | 38.42 (6) | 67 | 1.26 |
| 7 | K - 0307 | 90.99 (4) | 33.33 (5) | 46.2 (3) | 11.26 (4) | 6.4 (8) | 52.4 (5) | 2 (8) | 19 (7) | 39.2 (10) | 12 (3) | 30.73 (8) | 39 (4) | 69 | 1.3 |
| 8 | MACS - 6222 | 90.87 (5) | 37.45 (8) | 44.87 (8) | 10.7 (6) | 7.4 (4) | 63.07 (1) | 2.33 (1) | 19.67 (4) | 39.67 (9) | 12.53 (1) | 32.4 (5) | 38.52 (5) | 57 | 1.08 |
| 9 | MAHYCO GOAL | 89.29 (9) | 34.32 (7) | 45 (7) | 11.65 (2) | 5.8 (12) | 49.07 (7) | 2 (8) | 18.87 (8) | 40.47 (8) | 9.93 (11) | 27.53 (10) | 35.34 (8) | 97 | 1.83 |
| 10 | PBW - 343 | 82.33 (13) | 32.18 (4) | 36.67 (13) | 9.37 (13) | 6.4 (8) | 35.53 (13) | 1.93 (11) | 16.6 (11) | 44.6 (2) | 8.73 (13) | 21.4 (13) | 42.96 (1) | 115 | 2.17 |
| 11 | SHREE RAM - 303 | 84.49 (12) | 33.37 (6) | 42.35 (11) | 11.39 (3) | 5.53 (13) | 46.8 (8) | 2.07 (7) | 19.33 (5) | 42.8 (4) | 9.07 (12) | 23.93 (12) | 39.56 (2) | 95 | 1.79 |
| 12 | UP - 2672 | 89.85 (7) | 38.97 (10) | 45.71 (5) | 10.4 (8) | 7.47 (3) | 45.07 (9) | 2.27 (2) | 17.93 (9) | 43 (3) | 10.27 (9) | 31.8 (7) | 33.63 (11) | 83 | 1.57 |
| 13 | WB - 2 | 88.11 (10) | 26.28 (1) | 39.55 (12) | 10.07 (10) | 6.27 (11) | 57.53 (3) | 2.27 (2) | 20.53 (2) | 38.2 (12) | 11.53 (5) | 28.53 (9) | 39.22 (3) | 80 | 1.51 |

*Table 5:* Precis(e) varietal recommendation: sorting on CR or NCR values

| S. No. | GENOTYPES ↓ | Plant height (cm) | Flag leaf area (cm2 ) | Peduncle length (cm ) | Spike length / plant (cm ) | No. Of productive tillers | Grain no | Grain weight (g) | Spikelets | Test weight (g) | Grain yield (g/plant) | Biological yield (g/plant) | Harvest index (%) | CR | NCR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sort Order→ | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 1 | HD - 2967 | 92.27 (2) | 31.11 (2) | 44.45 (9) | 12.31 (1) | 7.2 (5) | 43.4 (11) | 2.2 (4) | 21.67 (1) | 47.73 (1) | 11.93 (4) | 35.33 (1) | 33.51 (12) | 53 | 1 |
| 2 | MACS - 6222 | 90.87 (5) | 37.45 (8) | 44.87 (8) | 10.7 (6) | 7.4 (4) | 63.07 (1) | 2.33 (1) | 19.67 (4) | 39.67 (9) | 12.53 (1) | 32.4 (5) | 38.52 (5) | 57 | 1.08 |
| 3 | HUW - 669 | 90.87 (5) | 38.19 (9) | 43.81 (10) | 11.06 (5) | 6.47 (7) | 55.73 (4) | 2.2 (4) | 19.73 (3) | 41.13 (6) | 12.2 (2) | 32.2 (6) | 38.42 (6) | 67 | 1.26 |
| 4 | K - 0307 | 90.99 (4) | 33.33 (5) | 46.2 (3) | 11.26 (4) | 6.4 (8) | 52.4 (5) | 2 (8) | 19 (7) | 39.2 (10) | 12 (3) | 30.73 (8) | 39 (4) | 69 | 1.3 |
| 5 | HUW - 213 | 97.57 (1) | 41.91 (13) | 50.71 (1) | 9.86 (11) | 7.87 (1) | 59.67 (2) | 2.13 (6) | 19.07 (6) | 38.33 (11) | 11.33 (6) | 32.67 (4) | 34.79 (9) | 71 | 1.34 |
| 6 | WB - 2 | 88.11 (10) | 26.28 (1) | 39.55 (12) | 10.07 (10) | 6.27 (11) | 57.53 (3) | 2.27 (2) | 20.53 (2) | 38.2 (12) | 11.53 (5) | 28.53 (9) | 39.22 (3) | 80 | 1.51 |
| 7 | UP - 2672 | 89.85 (7) | 38.97 (10) | 45.71 (5) | 10.4 (8) | 7.47 (3) | 45.07 (9) | 2.27 (2) | 17.93 (9) | 43 (3) | 10.27 (9) | 31.8 (7) | 33.63 (11) | 83 | 1.57 |
| 8 | HD - 3086 | 91.6 (3) | 31.27 (3) | 46.38 (2) | 9.66 (12) | 6.8 (6) | 49.4 (6) | 2 (8) | 16.93 (10) | 36.13 (13) | 10.07 (10) | 27.53 (10) | 37.01 (7) | 90 | 1.7 |
| 9 | SHREE RAM - 303 | 84.49 (12) | 33.37 (6) | 42.35 (11) | 11.39 (3) | 5.53 (13) | 46.8 (8) | 2.07 (7) | 19.33 (5) | 42.8 (4) | 9.07 (12) | 23.93 (12) | 39.56 (2) | 95 | 1.79 |
| 10 | MAHYCO GOAL | 89.29 (9) | 34.32 (7) | 45 (7) | 11.65 (2) | 5.8 (12) | 49.07 (7) | 2 (8) | 18.87 (8) | 40.47 (8) | 9.93 (11) | 27.53 (10) | 35.34 (8) | 97 | 1.83 |
| 11 | HUW - 510 | 85.75 (11) | 41.86 (12) | 46.08 (4) | 10.33 (9) | 7.67 (2) | 43.2 (12) | 1.87 (12) | 16.4 (12) | 42.33 (5) | 11.27 (7) | 33.33 (2) | 34 (10) | 98 | 1.85 |
| 12 | HUW - 37 | 89.41 (8) | 40.79 (11) | 45.29 (6) | 10.47 (7) | 6.33 (10) | 44.13 (10) | 1.73 (13) | 16.4 (12) | 40.87 (7) | 10.6 (8) | 33.13 (3) | 32.07 (13) | 108 | 2.04 |
| 13 | PBW - 343 | 82.33 (13) | 32.18 (4) | 36.67 (13) | 9.37 (13) | 6.4 (8) | 35.53 (13) | 1.93 (11) | 16.6 (11) | 44.6 (2) | 8.73 (13) | 21.4 (13) | 42.96 (1) | 115 | 2.17 |

## References Références Referencias


1. Donald, C.M. (1968). The breeding of crop ideotype. *Euphytica,* 17: 385-403.
2. Gaur, S.C., Singh, S.N. and Chand, S. (2010). Screening of newly released varieties in the catchment of Kurna river in the foothlls of the Himalayas. *Progressive Research,* 5 (Special): 326-328.
3. Singh, S.N. 2017. Normalized Cumulative Ranks for Plant Breeding: An Example. *Frontiers in Crop Improvement Journal* Vol. 5 (Spl.): 304-306. Print ISSN: 2393-8234; Online ISSN: 2454-6011.
4. Singh, S.N., Sahu, R.K. and Tarkeshwar (2018). Selection from quinoa (*Chenopodium quinoa*Willd.) accessions through normalized cumulative ranks. *Progressive Research – An International Journal,*Volume 13 (Special): 537-538.
5. Yadav, M., Singh, S.N., Tarkeshwar, Sahu, R.K., Kumar, K. and Yadav, P.K. (2020). Selecting suitable wheat (T*riticum aestivum*L.) variety for Gorakhpur and Deoria region through normalized cumulative ranks. *Int. J. Curr. Microbiol. App. Sci,* Special Issue-11: 556-560.