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Relative Performance and Karnal Bunt Infestation of Wheat (*Triticum Aestivum* L. Em. Thell.) Accessions in Eastern Uttar Pradesh

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Abstract- Twenty wheat accessions were evaluated on 11 parameters in an experiment at Center for Research and Development (CRD), Gaunar, Usaraha, Gorakhpur, U. P. in a randomized block design with three replications. The objectives of the experiment were to assess the relative performance of the accessions on various parameters and extent of Karnal bunt (KB) infestation. Normalized cumulative ranks were used to assess the relative performance of accessions. KOH seed soaking technique was used to assess the extent of Karnal bunt infestation. Based on normalized accumulating ranks the performance order of wheat accessions is BHU-25, HPST-16-17-16, HPAN-101,HPAN-57, PBW-677, CRD Gehu 1, BHU-31, ANKUR, HPST-16-17-07, HPAN-111, HPAN-127, HPAN-65, HPST-16-17-15, PBW-Zn 1, HPAN-42, HPAN-164, HD-2967, WB-02, ZINCOL and HPAN-147. All the 20 accessions of wheat were susceptible to Karnal bunt and infestation ranged from 3.67% (HPST-16-17-15) to 70.33% (HPAN-147).

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Abstract- Twenty wheat accessions were evaluated on 11 parameters in an experiment at Center for Research and Development (CRD), Gaunar, Usaraha, Gorakhpur, U. P. in a randomized block design with three replications. The objectives of the experiment were to assess the relative performance of the accessions on various parameters and extent of Karnal bunt (KB) infestation. Normalized cumulative ranks were used to assess the relative performance of accessions. KOH seed soaking technique was used to assess the extent of Karnal bunt infestation. Based on normalized accumulating ranks the performance order of wheat accessions is BHU-25, HPST-16-17-16, HPAN-101,HPAN-57, PBW-677, CRD Gehu 1, BHU-31, ANKUR, HPST-16-17-07, HPAN-111, HPAN-127, HPAN-65, HPST-16-17-15, PBW-Zn 1, HPAN-42, HPAN-164, HD-2967, WB-02, ZINCOL and HPAN-147. All the 20 accessions of wheat were susceptible to Karnal bunt and infestation ranged from 3.67% (HPST-16-17-15) to 70.33% (HPAN-147). High performers and least bunt infested accessions like BHU-25, HPST-16-17-16, HPAN-101, HPAN-57 and PBW-677 could be further investigated or directly recommended for cultivation in this area.

Keywords: ideotype, karnal bunt, normalized cumulative ranks, selection.

I. Introduction

Wheat is a very staple food crop of people in the world. However its production is limited by non-availability of suitable varieties and infestation of diseases and pests. Therefore, plant breeders' duty is to provide suitable varieties to farmers so that food production and food security can be insured. With these facts in mind, we evaluated 20-wheat accessions on 11 parameters including a test for Karnal bunt infestation. The present paper reports the findings of this experiment.

II. Materials and Methods

The experiment was conducted in Rabi season 2019-20 at Center for Research and Development located at Gaunar-Usaraha, Gorakhpur, Uttar Pradesh. The experimental site is located at 26° 42' 45.5" N latitude, 83° 36' 36.6" E longitude and 86 m above mean sea level. The climate is semi-arid with hot summer and cold winter. Nearly 80% of the rainfall is received during monsoon and a few winter showers.

Twenty wheat germplasm, included in this experiment, were taken from the germplasm stock available at CRD and BRD PG College, Deoria. HD2967 was used as a standard check variety. These accessions were raised in a randomized block design in a timely sown condition with standard package of practices for wheat cultivation. Thus, 20 genotypes were evaluated on 11 parameters in three replications. The parameters evaluated are 1. 1000 seed weight or test weight, 2. 10 spikes' weight, 3. yield per plot, 4. spikes per square meter, 5. effective tillers, 6. Plant height, 7.yield per hectare, 8. biological yield per plant, 9.days to 50% flowering, 10. flag leaf area and 11. Karnal bunt infestation.

Data collected on five randomly selected plants of all 20 genotypes were compiled to calculate means in three replications. These were further used to calculate replication mean. These values were subjected to normalized cumulative rank (NCR) analysis as discussed by Singh and co-workers in many papers (Sanoj Kumar 2021; Singh 2017; Singh et al. 2018; Yadav et al. 2020). The idea of this analysis came from the concept of crop ideotype as given by Donald 1968. That is why, in this analysis, we are looking for ideal plant types (=crop ideotypes) that would rank relatively well or first in all parameters.

III. Results and Discussion

Table 1 shows the average values of the replications.

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Table 1: Average Values of Three Replications

S.N.	Variety↓ Sort Order→	Test Weight	10 Spike Weight	Yield/ plot	Spikes/ m^2	Effective Tillers	Plant Height	Yield/ ha	Biological Yield/ Plant	D2-50%F	Flag Leaf Area	Karnal Bunt
		0	0	0	0	0	0	0	0	1	1	1
1	HPST-16-17-07	41.33	24.67	2.01	529.67	4.47	110.2	25.17	17.6	83	34.76	13.33
2	HPST-16-17-15	35.33	28.67	1.75	429	4.53	104.53	21.83	21.33	83	43.97	3.67
3	HPST-16-17-16	39.33	30	1.92	569.67	4.8	109.13	23.96	20.53	83	31.27	5
4	BHU-25	40	33.33	2.38	629.67	5.33	93.17	29.71	24.67	84	29.86	8
5	BHU-31	42.67	34.67	2.51	536.67	4.4	94.33	31.33	17.33	85.67	36.79	9
6	ZINCOL	36.67	31.33	1.56	439	3.73	103.93	19.46	17.87	91	32.01	6.67
7	ANKUR	40.67	30	1.72	451	4.53	105.9	21.46	19.73	87	34.72	4.67
8	PBW-Zn 1	38.67	27.33	1.88	464.33	4.53	105.43	23.5	18.4	83	38.91	18.33
9	WB-02	38	25.33	1.67	684.33	4.4	98.3	20.92	17.2	83	37.21	10
10	HPAN-101	44	24	2.22	552	5.2	104.77	27.71	28.13	87	33.85	7.67
11	HPAN-147	46	26	1.16	589.67	4.47	90.69	14.54	17.87	91	38.49	70.33
12	HPAN-164	35.33	25.33	1.92	586	3.73	102.2	23.96	19.07	87	36.6	7.33
13	HPAN-42	38	29.33	2.77	486.67	4.47	103.8	34.63	16.47	85	53.03	10.33
14	HPAN-57	43.33	28.67	1.83	559.33	4.6	99.9	22.82	21.87	83	34.99	7.33
15	HPAN-65	36.67	32.67	2.8	485	4.33	104.5	35	20.8	86	40.77	21
16	HPAN-111	42	24	2.31	506.33	5.53	101.03	28.88	22	87	40.14	16.67
17	HPAN-127	43.33	27.33	2.27	553.33	4.4	99.7	28.33	19.2	87	40	9
18	CRD Gehu 1	56.67	29.33	1.69	272.67	7.93	112.53	21.15	45.6	79	61.06	8
19	PBW-677	42.67	26.67	2.94	480.33	5.33	102.23	36.75	21.6	87	41.91	6
20	HD-2967	40	27.33	2.13	433	5	95.6	26.67	17.73	87	39.65	32.67

Table 2 shows ranks, cumulative ranks (CR) and NCR values of genotypes.

Table 2: Ranks, CR and NCR Values of Genotypes

S.N.	Variety↓ Sort Order→	Test Weight	10 Spike Weight	Yield/ plot	Spikes/ m^2	Effective Tillers	Plant Height	Yield/ ha	Biological Yield/ Plant	D2-50%F	Flag Leaf Area	Karnal Bunt	CR	NCR
		0	0	0	0	0	0	0	0	1	1	1		
1	HPST-16-17-07	9	18	10	10	12	2	10	17	2	6	15	111	1.63
2	HPST-16-17-15	19	9	15	19	9	7	15	7	2	18	1	121	1.78
3	HPST-16-17-16	13	5	11	5	7	3	11	9	2	2	3	71	1.04
4	BHU-25	11	2	5	2	3	19	5	3	8	1	9	68	1
5	BHU-31	6	1	4	9	15	18	4	18	10	9	11	105	1.54
6	ZINCOL	17	4	19	17	19	9	19	14	19	3	5	145	2.13
7	ANKUR	10	5	16	16	9	4	16	10	12	5	2	105	1.54
8	PBW-Zn 1	14	11	13	15	9	5	13	13	2	12	17	124	1.82
9	WB-02	15	16	18	1	15	16	18	19	2	10	13	143	2.1
10	HPAN-101	3	19	8	8	5	6	8	2	12	4	8	83	1.22
11	HPAN-147	2	15	20	3	12	20	20	14	19	11	20	156	2.29
12	HPAN-164	19	16	11	4	19	12	11	12	12	8	6	130	1.91
13	HPAN-42	15	7	3	12	12	10	3	20	9	19	14	124	1.82
14	HPAN-57	4	9	14	6	8	14	14	5	2	7	6	89	1.31
15	HPAN-65	17	3	2	13	18	8	2	8	11	16	18	116	1.71
16	HPAN-111	8	19	6	11	2	13	6	4	12	15	16	112	1.65
17	HPAN-127	4	11	7	7	15	15	7	11	12	14	11	114	1.68
18	CRD Gehu 1	1	7	17	20	1	1	17	1	1	20	9	95	1.4
19	PBW-677	6	14	1	14	3	11	1	6	12	17	4	89	1.31
20	HD-2967	11	11	9	18	6	17	9	16	12	13	19	141	2.07

On sorting the table 2, on the basis of CR or NCR in increasing order, we get table 3.

Table 3: Ranks, CR and NCR Similar to Table 2, but the Data are Sorted in Increasing Order based on CR or NCR

S.N.	Variety↓ Sort Order→	Test Weight	10 Spike Weight	Yield/ plot	Spikes/ m^2	Effective Tillers	Plant Height	Yield/ ha	Biological Yield/ Plant	D2-50%F	Flag Leaf Area	Karnal Bunt	CR	NCR
		0	0	0	0	0	0	0	0	1	1	1		
1	BHU-25	11	2	5	2	3	19	5	3	8	1	9	68	1
2	HPST-16-17-16	13	5	11	5	7	3	11	9	2	2	3	71	1.04
3	HPAN-101	3	19	8	8	5	6	8	2	12	4	8	83	1.22
4	HPAN-57	4	9	14	6	8	14	14	5	2	7	6	89	1.31
5	PBW-677	6	14	1	14	3	11	1	6	12	17	4	89	1.31
6	CRD Gehu 1	1	7	17	20	1	1	17	1	1	20	9	95	1.4
7	BHU-31	6	1	4	9	15	18	4	18	10	9	11	105	1.54
8	ANKUR	10	5	16	16	9	4	16	10	12	5	2	105	1.54
9	HPST-16-17-07	9	18	10	10	12	2	10	17	2	6	15	111	1.63
10	HPAN-111	8	19	6	11	2	13	6	4	12	15	16	112	1.65
11	HPAN-127	4	11	7	7	15	15	7	11	12	14	11	114	1.68
12	HPAN-65	17	3	2	13	18	8	2	8	11	16	18	116	1.71
13	HPST-16-17-15	19	9	15	19	9	7	15	7	2	18	1	121	1.78
14	PBW-Zn 1	14	11	13	15	9	5	13	13	2	12	17	124	1.82
15	HPAN-42	15	7	3	12	12	10	3	20	9	19	14	124	1.82
16	HPAN-164	19	16	11	4	19	12	11	12	12	8	6	130	1.91
17	HD-2967	11	11	9	18	6	17	9	16	12	13	19	141	2.07
18	WB-02	15	16	18	1	15	16	18	19	2	10	13	143	2.1
19	ZINCOL	17	4	19	17	19	9	19	14	19	3	5	145	2.13
20	HPAN-147	2	15	20	3	12	20	20	14	19	11	20	156	2.29

Top few accessions of table 3 could be recommended for cultivation as they might be close to ideal plant type we are looking for. From table 3, it is clear that top 5 or 6 genotypes *viz*., BHU-25, HPST-16-17-16, HPAN-101, HPAN-57, PBW-677 and CRD Gehun-1 could be recommended to farmers for cultivation in this region. Standard check variety HD-2967 is lagging far behind on 17th position in table 3. Therefore, top varieties are highly likely to replace the current standard check variety HD-2967gradually. However, it is also clear from table 1, 2 and 3 that none of these varieties are completely resistant to Karnal bunt. The extent of Karnal bunt infestation is ranging from 3.67% to 70.3 3%. In worst case scenario, the less infested varieties with high relative performance could be recommended for cultivation. However, in a similar study at the same research station, another researcher (Sanoj Kumar 2021, personal communication) has found four accessions completely resistant to Karnal bunt out of 20 screened accessions. These are HPYT-409, HPAN-153, HPYT-489 and HPYT 490. These varieties, totally resistant to Karnal bunt, should be recommended for cultivation in this region. Karnal bunt has shown its presence in this region and it should be controlled in its initial stages.

This analysis is shown step by step for the comprehension of students, but to be precise, table 1 and table 2 could be merged into a single table and again the data could be sorted in increasing order based on CR or NCR. Thus, the whole paper could be summarized in a single table as given in table 4. This is being referred to as precise varietal recommender system.

Table 4: Precise Varietal Recommender System

S.N.	Variety↓ Sort Order→	Test Weight	10 Spike Weight	Yield/ plot	Spikes/ m^2	Effective Tillers	Plant Height	Yield/ ha	Biological Yield/ Plant	D2-50%F	Flag Leaf Area	Karnal Bunt	CR	NCR
		0	0	0	0	0	0	0	0	1	1	1		
1	BHU-25	40 (11)	33.33 (2)	2.38 (5)	629.67 (2)	5.33 (3)	93.17 (19)	29.71 (5)	24.67 (3)	84 (8)	29.86 (1)	8 (9)	68	1
2	HPST-16-17-16	39.33 (13)	30 (5)	1.92 (11)	569.67 (5)	4.8 (7)	109.13 (3)	23.96 (11)	20.53 (9)	83 (2)	31.27 (2)	5 (3)	71	1.04
3	HPAN-101	44 (3)	24 (19)	2.22 (8)	552 (8)	5.2 (5)	104.77 (6)	27.71 (8)	28.13 (2)	87 (12)	33.85 (4)	7.67 (8)	83	1.22
4	HPAN-57	43.33 (4)	28.67 (9)	1.83 (14)	559.33 (6)	4.6 (8)	99.9 (14)	22.82 (14)	21.87 (5)	83 (2)	34.99 (7)	7.33 (6)	89	1.31
5	PBW-677	42.67 (6)	26.67 (14)	2.94 (1)	480.33 (14)	5.33 (3)	102.23 (11)	36.75 (1)	21.6 (6)	87 (12)	41.91 (17)	6 (4)	89	1.31
6	CRD Gehu 1	56.67 (1)	29.33 (7)	1.69 (17)	272.67 (20)	7.93 (1)	112.53 (1)	21.15 (17)	45.6 (1)	79 (1)	61.06 (20)	8 (9)	95	1.4
7	BHU-31	42.67 (6)	34.67 (1)	2.51 (4)	536.67 (9)	4.4 (15)	94.33 (18)	31.33 (4)	17.33 (18)	85.67 (10)	36.79 (9)	9 (11)	105	1.54
8	ANKUR	40.67 (10)	30 (5)	1.72 (16)	451 (16)	4.53 (9)	105.9 (4)	21.46 (16)	19.73 (10)	87 (12)	34.72 (5)	4.67 (2)	105	1.54
9	HPST-16-17-07	41.33 (9)	24.67 (18)	2.01 (10)	529.67 (10)	4.47 (12)	110.2 (2)	25.17 (10)	17.6 (17)	83 (2)	34.76 (6)	13.33 (15)	111	1.63
10	HPAN-111	42 (8)	24 (19)	2.31 (6)	506.33 (11)	5.53 (2)	101.03 (13)	28.88 (6)	22 (4)	87 (12)	40.14 (15)	16.67 (16)	112	1.65
11	HPAN-127	43.33 (4)	27.33 (11)	2.27 (7)	553.33 (7)	4.4 (15)	99.7 (15)	28.33 (7)	19.2 (11)	87 (12)	40 (14)	9 (11)	114	1.68
12	HPAN-65	36.67 (17)	32.67 (3)	2.8 (2)	485 (13)	4.33 (18)	104.5 (8)	35 (2)	20.8 (8)	86 (11)	40.77 (16)	21 (18)	116	1.71
13	HPST-16-17-15	35.33 (19)	28.67 (9)	1.75 (15)	429 (19)	4.53 (9)	104.53 (7)	21.83 (15)	21.33 (7)	83 (2)	43.97 (18)	3.67 (1)	121	1.78
14	PBW-Zn 1	38.67 (14)	27.33 (11)	1.88 (13)	464.33 (15)	4.53 (9)	105.43 (5)	23.5 (13)	18.4 (13)	83 (2)	38.91 (12)	18.33 (17)	124	1.82
15	HPAN-42	38 (15)	29.33 (7)	2.77 (3)	486.67 (12)	4.47 (12)	103.8 (10)	34.63 (3)	16.47 (20)	85 (9)	53.03 (19)	10.33 (14)	124	1.82
16	HPAN-164	35.33 (19)	25.33 (16)	1.92 (11)	586 (4)	3.73 (19)	102.2 (12)	23.96 (11)	19.07 (12)	87 (12)	36.6 (8)	7.33 (6)	130	1.91
17	HD-2967	40 (11)	27.33 (11)	2.13 (9)	433 (18)	5 (6)	95.6 (17)	26.67 (9)	17.73 (16)	87 (12)	39.65 (13)	32.67 (19)	141	2.07
18	WB-02	38 (15)	25.33 (16)	1.67 (18)	684.33 (1)	4.4 (15)	98.3 (16)	20.92 (18)	17.2 (19)	83 (2)	37.21 (10)	10 (13)	143	2.1
19	ZINCOL	36.67 (17)	31.33 (4)	1.56 (19)	439 (17)	3.73 (19)	103.93 (9)	19.46 (19)	17.87 (14)	91 (19)	32.01 (3)	6.67 (5)	145	2.13
20	HPAN-147	46 (2)	26 (15)	1.16 (20)	589.67 (3)	4.47 (12)	90.69 (20)	14.54 (20)	17.87 (14)	91 (19)	38.49 (11)	70.33 (20)	156	2.29

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