ANNUAL REPORT

2019–20

WHEAT RESEARCH INSTITUTE

FAISALABAD

INTRODUCTION

Wheat Research Institute (WRI) has been working to release bread wheat, barley and durum varieties possessing better yield potential and quality characteristics, tolerance to biotic (insect pests and disease) and abiotic (drought, heat and salinity) stresses as well as their production technology since its establishment in 1906 as Cereal Section at Ayub Agricultural Research Institute, Faisalabad. It has contributed so far more than 80 varieties of bread wheat, durum and barley. Some of these varieties like Chenab.70, Pak81, Inqilab.91, Seher-06, Faisalabad-08 and Galaxy-13 remained as the mega wheat varieties of Pakistan. During the last five years, this institute released two wheat varieties i.e. Anaj-17, Akbar-19 and two barley varieties i.e. Sultan-17 and Jau-17.

This Institute is linked with important national and international institutes; notables are International Maize and Wheat improvement Center (CIMMYT), Mexico and International Center for Agricultural Research in Dry Area (ICARDA), Syria that provides new germplasm to the breeders. In return, WRI, Faisalabad helps the breeders of other institutes and student with new plant material for the development of varieties of their own choice. Five disciplines i.e. breeding, pathology, entomology, agronomy and cereal technology are working in the institute. Breeding is a pivotal part of its activities as it focus on various aspects of wheat crop like drought, heat, salt tolerance, insect resistance and durable rust resistance.

Table 1: Area, Production and Yield of wheat

Years	Area (000 ha)		Production (000 tons)		Yield (Kg ha^{-1})	
	Punjab	**Pakistan**	**Punjab**	**Pakistan**	**Punjab**	**Pakistan**
2017-18	6560	8797	19179	25076	2924	2795
2018-19	6496	8740	18378	25195	2829	2883
2019-20	6515	8813	19660	27030	3017	3067

In bread wheat during the year under report about 800 F_0 crosses were harvested. 847 $F_{1,}$ crosses were studied, out of which 803 crosses were selected. 713 F_2 crosses were selected and bulked out of 997 F_2 crosses. In F3 generations, 549 crosses out of 762 were selected. In F_4 generations 253 crosses were selected out of 394. In F_5 generation 185 crosses were selected out of 234 crosses for further study. In F_6 generations 993 single head row progenies of 100 crosses were selected from 4043 head rows of 140 crosses. In F_7 generations 194 progenies from 48 crosses were selected out of 636 progenies of 82 crosses which were promoted for preliminary yield trials.

As regards durum wheat 246 CB lines, 49 F1 crosses, 50 F2, 31 F3 lines, 21 F4 crosses were selected. 200 head rows of 10 crosses in F5 and 97 F6 lines out of 285 were selected. 56 lines were finally selected in F7 out of 70. With respect to barley in station yield trials 15 lines were found higher yielder in A-trials, while 7 entries found higher yielder in B-trial than check. Besides, agronomic, entomological, pathological and cereal technological aspects were also studied.

A series of in house seminars were held in which young scientists of the wheat Directorate participated and presented papers on various issues and aspects regarding Wheat Breeding, Agronomy, Entomology and Pathology. Finally according to the conclusions, recommendations were prepared which will be fruitful for rising per acre yield. Similarly, Kisan Melas were also held where different recommended varieties were introduced and their package of production technology was explained.

CLIMATE/WEATHER:

Weather plays a pivotal role in crop production it interacts with the physiological and biochemical processes of the plant. Favorable weather promotes good crop production while abrupt weather adversely affects the crop. It remained normal at early growth stages. The low temperature during December and January promoted tillering. During the current year, 5 frosty nights beginning from December to January were observed. Rainfall during the month of March and April helped in avoiding drastic temperature effects that resulted in better growth and grain development. The total rain received during the wheat season was 241 mm. However in upper Punjab irrigated areas excessive moisture negatively affected the crop. The meteorological data is shown in the table 2.

Table 2: Meteorological Data during the Crop Season 2019-20

Month	Av. Maximum (C^0)	Av Minimum (C^0)	Av Relative Humidity (%)	Rainfall (mm)	Av Sunshine Hours	Frosty nights
November	26.3	12.8	55.4-82.2	3	5h 19m	-
December	17	6	0.4-67	7	3h 23m	2
January	17.3	5.5	0.4-60.3	50.8	4h 43m	3
February	23.8	8.7	46.4-83.4	24.8	7h 21m	-
March	24.5	13.9	62.4-85	135	6h 06m	-
April	33.1	18.8	51.7-69.7	20.4	8h 57m	-

BREAD WHEAT (Triticum aestivum L.)

Germplasm Improvement and its Maintenance

Crossing Block

The role of germplasm improvement of wheat has been well recognized. Germplasm maintenance and evaluation, is the main objective which covers the whole range of activities starting from collection of samples, its characterization, evaluation, and documentation. Germplasm improvement and maintenance provides an opportunity to incorporate the desirable genes in the existing varieties through hybridization. The main objective of crossing block were to maintain genotypes/lines with their typical characteristic and to combine high yield, adaptability and tolerance to biotic and abiotic stresses, quality and other desirable traits. During this season crossing block comprised of 376 wide diversified entries which was planted twice i.e. (1^{st} and 4^{th} week of November) to get synchronization of desirable male and female parents. The crossing Block composed of different groups viz; current varieties (56), exotic lines (10), disease resistant (41), drought tolerant (10), salt tolerant (11), heat tolerant (32), grain quality (8), high grain weight (3), high yielding (172), harvest plus (25) and CSISA (8). Data were recorded for 12 different traits. In crossing block entries, a wide range of variability for each trait was observed (Table 3).

Table 3: Genetic diversity of different traits in crossing block during 2019-20.

Traits	Range	Traits	Range
Days to heading	98-126	Tillers/plant	6.5-26.9
Days to maturity	151-167	1000 grain weight (g)	17.0-50.2
Plant height (cm)	68-135	Leaf and yellow rusts	0-100S
Protein content (%)	10.8-16.4	Gluten content (%)	18-35
Canopy temperature (^{0}c) (booting)	14.0-19.2	NDVI range (booting)	0.70-0.86
Leaf color (light green, medium. dark), size (Broad, medium, narrow) & orientation (droopy, semi droopy, erect, semi erect)			Wide range

About 750 target crosses were made keeping in view different objectives like higher yield, heat, drought, disease resistance and acceptable quality.

Pre-breeding Nursery (PBN)

Pre-breeding is an alternative term used for genetic enhancement as it is the sophisticated process and essential planned part of moving the desired resistance genes into genetic backgrounds which allow direct use in wheat breeding programs. 386 top performing lines were sown on 01-11-2018 from international nurseries during the year 2018-19. Data regarding following traits showed in table 4.

Table 4: Genetic diversity of different traits in PBN during 2019-20.

Traits	Range	Traits	Range
Plant height (cm)	90-150	Canopy Temperature(^{o}c)	11.4-19.3
Days to heading	73-108	Leaf & yellow rust	0-100S
Days to maturity	141-150	Leaf color, size and orientation	Wide range

Local Land Races

The exploitation of local land races for cultivar improvement is limited by crossing incompatibility barrier and linkage drags but it is an urgent need to conserve as many land-races as possible to ensure that genetic diversity may not lost as these are characterized by disease resistance and better able to withstand the challenges posed by environmental stresses. Therefore, this factor necessitate to conserve these land races to ensure the genetic diversity. Local land races included 45 entries. These entries were evaluated for agronomic and pathological aspects for inclusion in the breeding program (table 5).

Table 5: Genetic Diversity in Local Land Races During 2019-20.

Sr. No.	Traits	*LLR Range*
1	Plant height (cm)	82-137
2	Days to heading	97-128
3	Days to maturity	158-165
5	Tiller/plant	7.8-15.4
6	Canopy temperature (^{0}c) (booting)	11.8-19.2
7	NDVI range (booting)	0.73-0.84
8	Leaf & yellow rust reactions	0- 100 S
9	Leaf color, size & orientation	Wide range

Hybrid Seed Program

Cytoplasmic Male Sterile (A) lines, maintainer line (B) and fertility restorer lines are the main components of hybrid seed production. Thirty-three A-lines (CMS lines) along with the same number of B-lines (maintainers) were planted in the field. Thirty-three CMS lines were maintained by crossing with their respective maintainer (B-lines). Sixteen fertility restorers were also maintained by selling

Hybrid yield trial 2019-20

Four hybrids (H-1, H-2, H-3, H-4) along with four (FSD-08, Galaxy-13, Ujala-16 and Anaj-17) local check varieties were sown in triplicates on 01-11-2019 in the farm area of wheat research institute, during the year 2019-20. Two hybrid performed better in terms of yield against check

Galaxy as shown in the given table 6. But economic Heterosis calculated over best check was low.

table 6: Genetic Diversity In Local Land Races During 2019-20

Varieties/lines	Height(cm)	Days to heading	Days to maturity	Yield/plot (kg/ha.)	% increase over Best check
FSD-08	105.7	101.66	154.33	2026	-
Galaxy-13	107.7	102.66	156	2768	-
Ujala-16	100.7	105.6	153	2324	-
Anaj-17	110.0	104	154.33	2253	-
H-1(E-7*HN-7)	107.3	102.66	154.66	2661	-3.86
H-2(E-53*HN-10)	110.7	101.33	156	3000	8.38
H-3(E-49*HN-10)	102.7	102	155.33	2920	5.49
H-4(E-13*HN-5)	107.3	103	154	2213	-20.05

PBN (Pre breeding Nursery)

Pre-breeding is a term used for evaluation of genepool accessions before their use in breeding. 386 top performing lines selected from various international nurseries and trials during 2018-19 season were sown in season 2019-20. Data regarding various traits showed in table 6.

Table 7: Genetic Diversity in Pre Breeding Nursery During 2018-19.

Sr. No.	Traits	Range
1	Plant height (cm)	90-150
2	Days to heading	73-108
3	Days to maturity	141-150
4	Canopy Temperature(^{o}c)	11.4-19.3
5	Leaf & yellow rust	0-100S
6	Leaf color, size and orientation	Wide range

SCREENING OF WHEAT GERMPLASM FOR ROOT CHARACTERISTICS

Fifty bread wheat genotypes including five checks Fsd-08, Millet-11, Chkwal-50, Ujala-16 and Anaj-17 was sown in 4-inch pvc pipe of 1-meter length filled with sand (measured quantity of sand and water) following CRD layout. Four seeds of each genotype were planted in pvc pipe. Data regarding root length, root weight, dry rot weight, total plant fresh weight, total plant dry weight, root-shoot ratio and canopy temp and chlorophyll contents was recorded at four leaf stage. Finally, lines were evaluated considering traits recorded (given Table 7)

Table 8: Genetic Diversity in Germplasm for Root Traits During 2019-20

Sr. No.	Traits	Range
1	Root length (cm)	27-126
2	Shoot length (cm)	27-97
3	Fresh root weight (gm)	1-25
4	Fresh shoot weight (gm)	5-40
5	root dry weight (gm)	1.5-9.7
6	shoot dry weight (gm)	3-18.9
7	Days to heading (days)	50-111
8	Days to maturity (days)	125-153
9	Spike length (cm)	5-12.3
10	Grain weight (gm)	6.25-28.25

Filial generations high yielding irrigated

250 fresh crosses of high yielding and rust resistance were attempted. F_2 generation was sown with 1.8 X 6m plot size. F_2 contained 143 entries and 69 entries were selected. F_3 contained 158 entries and 110 entries were selected. From F_4, 57 entries were selected out of 94 entries. While F_5 contained 36 entries and 25 entries were selected. F_6 generation was sown with plot size of 1 row x 2.5 m. F_6 contained 39 crosses and 1382 entries from which 26 crosses and 300 entries were selected. F7 generation was advanced by adopting selected bulk method. In F7, 20 crosses and 108 lines were tested and 14 crosses and 45 lines were selected and promoted for preliminary yield trials.

Filial Generation Durable Rust Resistance

200 fresh crosses of high yielding durable rust resistance were attempted. 233 entries of F_1 generation were sown with 1.8 X 6m plot size. F_2 contained 198 entries and 130 entries were selected. F_3 contained 134 entries, from which 84 entries were selected. From F_4 41 entries out of 61 were selected. While F_5 contained 45 entries and 700 single heads of 31 entries were selected. F_6 generation was sown with plot size of 1 row x 2.5 m. F_6 contained 160 head rows of 18 crosses and 69 entries from which 13 crosses were selected.

Filial Generations of Drought Tolerance

Three hundred and ten fresh crosses were attempted, out of which 299 were harvested. F_1 generation was planted in irrigated condition so that sufficient seed may be produced. F_2 to F_7 were planted in rainfed conditions and these generations were exposed to artificial rusts inoculated conditions. Entries/plants exhibiting drought tolerance, desirable plant height and diseases resistance were selected using selected bulk. The breeding material was planted during first fortnight of November, 2019 and fertilized @120:90:60 N: P: K kg ha^{-1}at sowing time. Plot

size of F_2-F_7 was 1.8x6m while single row of F_6 was sown in 2.5m length. 207, 242, 156, 104, 2492, 315 and 68 entries from F_1 to F_7 were selected, respectively.

Screening Bread Wheat Germplasm for Drought Tolerance

250 Wheat genotypes were sown in plot size of 2 rows of 2.5 meter length. The experiment was sown in augmented design under normal irrigation and water stress conditions. Whole material was divided into 5 sets each of fifty entries and the experimental field was also divided into five blocks. Fifty entries along with 5 checks (FSD-08, Dhurabi-11, Barani-17, Galaxy-13 & Anaj-17) were assigned to each block.

Table 9: Range of Various Traits under drought and normal conditions.

Traits	**Normal**	**Rainfed**
Days to heading	103-110	102-111
Days to maturity	138-145	139-145
Plant height (cm)	68-118	71-115
Grain yield/plant (g)	8.1-46.7	3.5-20.4
Grain weight/spike (g)	0.72-4.28	0.36-2.72

Table 10: Best Performing Genotypes under Drought and Normal Conditions.

Block #1	**Grain yield/plant (g)**			
	Genotype	**Normal**	**Genotype**	**Rainfed**
	45	30.77	41	20.13
	35	25.88	37	19.96
	41	25.69	35	19.44
	49	25.66	49	18.29
	37	25.52	31	16.57
	Check	17.1	**Check**	10.2
Block #2	**Grain yield/plant (g)**			
	Genotype	**Normal**	**Genotype**	**Rainfed**
	87	37.8	96	20.4
	96	37.1	71	20.2
	71	36.2	64	17.4
	58	33.6	51	17.3
	51	33.1	65	17.0
	Check	18.2	**Check**	10.6
Block #3	**Grain yield/plant (g)**			
	Genotype	**Normal**	**Genotype**	**Rainfed**
	139	46.7	108	19.1
	112	42.1	132	16.2
	146	41.1	112	15.6

	134	41.0	106	15.4
	147	40.3	119	14.4
	Check	30.2	**Check**	12.4
Block #4	**Grain yield/plant (g)**			
	Genotype	**Normal**	**Genotype**	**Rainfed**
	189	43.4	197	15.9
	157	37.1	199	14.5
	195	37.0	188	14.5
	184	36.8	155	13.9
	177	35.6	184	13.5
	Check	23.2	**Check**	8.0
Block #5	**Grain yield/plant (g)**			
	Genotype	**Normal**	**Genotype**	**Rainfed**
	205	39.1	201	17.6
	202	33.9	225	14.3
	208	32.6	203	14.3
	209	30.1	221	14.1
	235	28.8	216	14.1
	Check	20.5	**Check**	9.4

Filial Generations of Heat Tolerance Program

Two hundred and Sixty fresh crosses for heat tolerance were harvested. F_2-F_6 generations were sown during last week of November. Plot size of F_2-F_5 was 1.8x6m while single row of F_6 was sown in 1 m length. Data regarding disease incidence and plant type was recorded. At maturity, single heads from desirable plants of F_2, F_3 and F_4 were bulked to raise successive generations. The selected material was finally evaluated on grain basis. For generation advancement 289, 190, 50 crosses were finally selected from F_2, F_3, F_4 respectively.F5 contained 27 entries, out of which 23 crosses and 750 single heads were selected. In F6, 301 single head rows were selected from 600 single head rows. In F_7, 56 single head row progenies were selected.

Screening of Bread Wheat Material for Heat Tolerance

Three hundred forty three bread wheat genotypes were sown in 1 meter length inside and outside tunnel in 1st week of November 2019. The same set was sown late on 6th December 2019. Post anthesis heat shock was imposed by covering the tunnel with polypropylene sheet for about three weeks after anthesis.

Out of 343 entries, 13entries performed well in all three sets(normal, stress, late).

Table 11: Genetic diversity in Local Land races during 2018-19

Sr. #	Parentage	Relative yield late vs normal	Relative yield stress vs normal
81	SUNCO//TNMU/TUI	0.9	0.8
140	SHUHA-4//NS732/HER/3/ MILAN/DUCULA	0.9	0.7
338	SKD-1	0.8	0.7
144	TUKURU//BAV92/RAYON/6/NG8201/KAUZ/ 4/SHA7//PRL/VEE#6/3/FASAN/5/MILAN/KA UZ*2/7/KINGBIRD #1	0.9	0.8
305	HYT-70-36 PRL/2*PASTOR//KACHU	0.8	0.9
76	KIRITATI//SERI/RAYON	0.8	0.8
61	CHIRYA-3	0.8	0.7
91	YANG87-158*2//MILAN/SHA7	0.7	0.8
158	BORL14*2//KFA/2*KACHU	0.7	0.7
131	SAUAL/3/MILAN/S87230//BAV92	0.7	0.7
295	V-17086 T.DICOCCONCI9309/AE.SQUAROSSA (409)//MUTUS/3/2*MUTUS	0.7	0.7
133	MILAN/KAUZ//PRINIA/3/BAV92/4/ATTILA/ BAV92//PASTOR/5/CNO79//PF70354/MUS/3/ PASTOR /4/BAV92	0.7	0.7
304	HYT-70-20 SUP152/BAJ#1//KFA/2*KACHU	0.7	0.7
	PB-11	0.8	0.6
	JOHAR	0.7	0.6
	ANAJ	0.6	0.6

YIELD TRIALS

Station Yield Trials

The most promising lines selected from different sources i.e. F_7 generation, International nurseries/ trials, drought, heat stress and plant pathology program were evaluated in station yield trials (A & B Trials).

Preliminary wheat yield trial (A-Trial)

During the reported year, twenty one trials of bread wheat were conducted to test 307 entries under normal planting time and irrigated conditions. Each trial consisted of 15 test entries/lines with 3 check varieties FSD-08, Galaxy-13 and Anaj-17. The planting was done following randomized complete block design with three replications. Ninety five advance lines

were selected for evaluation in regular yield trials on the basis of promising performance (Table 14).

Table 12 : Yield Performance And Related Traits Of Promising Lines In Preliminary Yield Trials

Sr. No.	Variety Code	Days to 50 % Heading	Days to Maturity	Plant Height (cm)	Disease Reaction		Grain Yield (kg ha^{-1})
					Leaf Rust	Yellow Rust	
A-I Trial							
1	V-19002	104	150	92	TMR	5MSS	4769
2	V-19004	108	150	76	0	TMR	4545
3	V-19007	110	153	93	TR	TR	4479
4	V-19010	109	154	97	TMR	TMR	4455
Check	FSD-08	104	150	71	10MSS	10MSS	4352
Check	Galaxy-13	110	151	92	20S	20S	4353
Check	Anaj-17	108	152	87	0	TMSS	4508
						LSD	312
A-II Trial							
1	V-19016	103	150	85	TMRMS	TMRMS	4605
2	V-19018	107	150	100	0	TMRMS	4356
3	V-19019	110	152	99	0	5MR MSS	4421
4	V-19024	114	154	95	0	0	4380
5	V-19025	113	152	87	0	20MSS	4541
6	V-19026	109	151	88	0	20MSS	4290
7	V-19027	110	151	84	0	5MR MS	4294
8	V-19028	110	151	86	0	5MR MS	4298
9	V-19029	110	151	86	0	20MSS	4419
10	V-19030	111	151	88	0	20MRMSS	4366
Check	FSD-08	104	150	92	10MSS	10MSS	4199
Check	Galaxy-13	111	152	96	20S	20S	4179
Check	Anaj-17	108	152	90	0	TMSS	4232
						LSD	313
A-III Trial							
1	V-19031	110	150	90	0	30MSS	4294
2	V-19032	109	151	90	0	10MRMS	4798
3	V-19033	109	151	85	0	5MRMS/ 20MSS	4526
4	V-19034	109	150	92	0	TR	5139
5	V-19035	109	151	96	0	0	5020
6	V-19036	109	153	99	0	0	4520
7	V-19037	110	153	93	0	0	4611
8	V-19038	111	154	96	0	TR	4522

9	V-19039	113	155	90	0	TR	4500
10	V-19042	111	151	94	5MRMS/ 10MSS	0	4255
11	V-19043	107	150	103	5RMR	5RMR	4592
12	V-19044	109	152	93	5MRMS	5MRMS	4660
13	V-19045	110	151	96	0	TMR	4308
Check	FSD-08	104	150	80	10MSS	10MSS	4241
Check	Galaxy-13	110	153	92	20S	20S	4094
Check	Anaj-17	109	152	102	0	TMSS	3905
						LSD	268
A-IV Trial							
1	V-19051	111	152	93	0	10MRMSS	4603
2	V-19054	111	154	103	TMR	TMRMS	5245
3	V-19055	110	154	106	TR	TR	5479
Check	FSD-08	104	150	94	10MSS	10MSS	4456
Check	Galaxy-13	110	152	106	20S	20S	3779
Check	Anaj-17	108	151	93	0	TMSS	4096
						LSD	292
A-V Trial							
1	V-19063	108	151	99	5MSS	5MSS	4722
2	V-19064	109	153	101	0	TMSS	4331
3	V-19065	115	155	101	0	TMRMS	4477
4	V-19066	108	151	92	5MRMS	TMRMS	4203
5	V-19067	109	152	92	0	5MSS	4446
6	V-19073	113	152	87	0	TMRMS	4430
Check	FSD-08	104	150	81	10MSS	10MSS	3979
Check	Galaxy-13	110	152	93	20S	20S	3961
Check	Anaj-17	108	151	87	0	TMSS	4191
						LSD	316
A-VI Trial							
1	V-19078	109	151	74	0	5MRMSS	4703
2	V-19079	110	152	78	0	5MRMS	4911
3	V-19080	110	153	87	10MSS	5MSS	4529
4	V-19090	108	151	86	0	TMRMSS	4426
Check	FSD-08	107	150	74	10MSS	10MSS	4419
Check	Galaxy-13	111	152	94	20S	20S	3804
Check	Anaj-17	109	152	92	0	TMSS	4214
						LSD	278
A-VII Trial							
1	V-19094	108	151	86	0	TMS	4537
2	V-19097	107	150	90	TMRMS	5MSS	4786
3	V-19098	111	152	95	0	10MSS	4208
4	V-19100	108	151	93	0	10MSS	4310
5	V-19103	107	150	100	0	5MS	4672
Check	FSD-08	104	150	87	10MSS	10MSS	3971

Check	Galaxy-13	110	152	80	20S	20S	3627
Check	Anaj-17	109	152	90	0	TMSS	4201
						LSD	278
A-X Trial							
1	V-19149	105	146	84	Flecking	Flecking	4156
Check	FSD-08	101	142	84	10MSS	10MSS	2545
Check	Galaxy-13	104	144	83	40S	40S	2380
Check	Anaj-17	105	145	88	0	TMSS	3716
						LSD	308
A-XI Trial							
1	V-19151	104	143	90	TMR	TMR	3720
2	V-19152	104	144	90	TMRMS	TMRMS	3845
3	V-19153	102	143	90	5RMR	0	3701
4	V-19154	105	144	90	TR	TMS	3676
5	V-19158	104	144	83	TR	0/5MSS	4086
6	V-19160	107	147	83	TMR	TR	3728
7	V-19162	105	145	90	TR	TMRMS	3734
Check	FSD-08	101	143	84	10MSS	10MSS	2475
Check	Galaxy-13	105	144	78	40S	40S	2590
Check	Anaj-17	105	144	83	0	TMSS	3649
						LSD	318
A-XII Trial							
1	V-19171	105	145	85	TR	5MSS	3852
2	V-19175	105	144	86	TMS	TR	3889
3	V-19176	103	143	88	TMRMS	TR	3940
4	V-19177	105	144	86	TR	TR	4512
5	V-19178	105	144	80	TR	TR	3864
6	V-19179	104	143	88	TR	TR	4335
Check	FSD-08	101	142	80	10MSS	10MSS	2459
Check	Galaxy-13	105	143	89	40S	40S	2636
Check	Anaj-17	105	144	82	0	TMSS	3841
						LSD	325
A-XIII Trial							
1	V-19185	101	144	82	TMR	TMR	4018
2	V-19187	105	144	84	TR	TMSS	4129
3	V-19190	106	146	96	5MRMS	TMRMS	4105
Check	FSD-08	101	142	83	10MSS	10MSS	2527
Check	Galaxy-13	105	144	92	40S	40S	2633
Check	Anaj-17	105	144	90	0	TMSS	3998
						LSD	325
A-XIV Trial							
1	V-19197	105	147	82	5MRMS	TMRMS	3878
2	V-19198	104	146	73	TMRMS	0	3938
3	V-19200	104	147	94	5MSS	TMS	3718
4	V-19201	105	147	94	10RMR	TMSS	3765

5	V-19202	105	146	90	5R	TMR	3615
6	V-19204	106	148	84	5R	TMRMS	3841
7	V-19205	105	145	90	TR	TMSS	4033
8	V-19207	105	148	80	TMRMS	TMRMS	4166
Check	FSD-08	101	142	80	10MSS	10MSS	3066
Check	Galaxy-13	105	146	92	40S	40S	2368
Check	Anaj-17	105	147	82	0	TMSS	3510
						LSD	296
A-XV Trial							
1	V-19212	105	145	72	TMS	TMS	4113
2	V-19217	103	144	74	Flecking	TMS	4193
Check	FSD-08	101	143	81	10MSS	10MSS	2921
Check	Galaxy-13	105	144	85	40S	40S	2619
Check	Anaj-17	105	146	82	0	TMSS	4072
						LSD	279
A-XVI Trial							
1	V-19232	104	145	92	5R	5MSS	4024
2	V-19235	103	144	92	TR	TMSS	4049
Check	FSD-08	101	144	82	10MSS	10MSS	2817
Check	Galaxy-13	105	146	94	40S	40S	2483
Check	Anaj-17	103	146	92	0	TMSS	3876
						LSD	344
A-XVII Trial							
1	V-19242	105	146	85	10MSS	TMSS	3592
2	V-19243	105	148	83	TMRMS	TR	3635
3	V-19244	104	144	85	TR	TMS	3718
4	V-19246	105	145	88	TMS	TMRMS	3668
5	V-19247	104	144	82	TR	TR	3942
6	V-19248	103	145	81	TMRMS	TMRMS	3609
7	V-19249	105	146	96	TR	TR	3652
8	V-19252	103	147	80	TR	5MSS	4068
Check	FSD-08	101	143	84	10MSS	10MSS	2514
Check	Galaxy-13	105	145	87	40S	40S	2740
Check	Anaj-17	103	146	83	0	TMSS	3582
						LSD	290
A-XVIII Trial							
1	V-19259	104	147	74	0	TMSS	3773
2	V-19261	101	143	85	5MS	TMSS	3778
3	V-19264	105	146	82	TR	TMS	3720
4	V-19265	105	146	87	TR	TR	4177
Check	FSD-08	101	143	81	10MSS	10MSS	2607
Check	Galaxy-13	105	146	86	40S	40S	2652
Check	Anaj-17	103	145	82	0	TMSS	3685
						LSD	352
A-XIX Trial							

1	V-19272	101	143	78	TR	TMS	3848
2	V-19274	105	145	81	TMS	5MSS	3771
3	V-19276	105	147	70	TMRMS	TMRMS	3788
4	V-19282	105	145	82	5R	TMRMS	4461
Check	FSD-08	101	143	82	10MSS	10MSS	2794
Check	Galaxy-13	105	146	81	40S	40S	2615
Check	Anaj-17	104	146	85	0	TMSS	3827
						LSD	359
A-XX Trial							
1	V-19286	105	145	81	TMRMS	TMSS	3901
2	V-19290	106	146	80	TMRMS	5MSS	3602
3	V-19292	105	146	90	TR	TMSS	4022
4	V-19294	102	144	84	TMS	TR	4597
5	V-19300	104	145	80	TR	TMRMS	3646
Check	FSD-08	101	143	80	10MSS	10MSS	2442
Check	Galaxy-13	105	146	92	40S	40S	2728
Check	Anaj-17	105	145	80	0	TMSS	3597
						LSD	298
A-XXI Trial							
1	V-19367	106	155	83	TM	5MS	5016
Check	Anaj-17	105	153	102	TR	10MS	4101

A-Trial (Rainfed)

In A-I trial 26 advanced lines (out of 56) were found high yielding than the check varieties (Faisalabad-08, Chakwal-50, Ihsan-16 & Anaj-17) under rainfed conditions as given below;

Table 13: Yield of candidate lines in preliminary yield trials (Rainfed) 2019-20

A-I (Rainfed)		**FSD-08**	**CK-50**	**IHSAN-16**	**ANAJ-17**
		2985	2432	2559	3127
Variety Code	**Yield (kg ha^{-1})**	**Percentage increase over check varieties**			
V-19514	4657	56.03	91.5	82.0	48.9
V-19518	4485	50.24	84.4	75.2	43.4
V-19516	4160	39.38	71.1	62.6	33.1
V-19510	3929	31.63	61.6	53.5	25.6
V-19517	3627	21.49	49.1	41.7	16.0
V-19524	3596	20.46	47.8	40.5	15.0
V-19508	3559	19.22	46.3	39.1	13.8
V-19526	3552	19.01	46.1	38.8	13.6
V-19522	3506	17.46	44.2	37.0	12.1
V-19515	3423	14.67	40.7	33.8	9.5
V-19542	3417	14.46	40.5	33.5	9.3
V-19525	3410	14.25	40.2	33.3	9.1
V-19532	3373	13.01	38.7	31.8	7.9
V-19507	3367	12.81	38.5	31.6	7.7

V-19509	3358	12.50	38.1	31.2	7.4
V-19519	3312	10.95	36.2	29.4	5.9
V-19540	3259	9.19	34.0	27.4	4.2
V-19547	3253	8.98	33.8	27.1	4.0
V-19523	3213	7.64	32.1	25.6	2.7
V-19544	3207	7.43	31.9	25.3	2.6
V-19538	3198	7.12	31.5	25.0	2.3
V-19549	3182	6.60	30.8	24.3	1.8
V-19502	3154	5.67	29.7	23.3	0.9
V-19534	3142	5.26	29.2	22.8	0.5
V-19543	3139	5.16	29.1	22.7	0.4
V-19527	3130	4.85	28.7	22.3	0.1
LSD (0.05)=370.82, CV (%)=11.7					

In A-II trial 29 advanced lines (out of 83) were found high yielding than the check varieties (Faisalabad-08, Chakwal-50, Ihsan-16, Anaj-17, Galaxy-13 & Barani-17) under rainfed conditions as given below;

Table 14. Performance of Advance Lines in A-II Trial

A-II (Rainfed)		**FSD-08**	**CK-50**	**IHSAN-16**	**ANAJ-17**	**GALAXY-13**	**BARANI-17**
		2786	**1950**	**2732**	**2556**	**2490**	**2836**
Variety Code	**Yield**	**Percentage Increase over check varieties**					
V-19555	3617	29.8	85.5	32.4	41.5	45.3	27.5
V-19569	3614	29.7	85.3	32.3	41.4	45.1	27.4
V-19572	3452	23.9	77.0	26.4	35.1	38.7	21.7
V-19575	3440	23.5	76.4	25.9	34.6	38.1	21.3
V-19553	3377	21.2	73.2	23.6	32.1	35.6	19.1
V-19571	3325	19.3	70.5	21.7	30.1	33.5	17.2
V-19600	3267	17.3	67.5	19.6	27.8	31.2	15.2
V-19616	3231	16.0	65.7	18.3	26.4	29.8	13.9
V-19562	3087	10.8	58.3	13.0	20.8	24.0	8.9
V-19622	3082	10.6	58.1	12.8	20.6	23.8	8.7
V-19614	3066	10.1	57.2	12.2	20.0	23.1	8.1
V-19560	3064	10.0	57.1	12.1	19.9	23.0	8.0
V-19606	3062	9.9	57.0	12.1	19.8	23.0	8.0
V-19556	3061	9.9	57.0	12.0	19.8	22.9	7.9
V-19564	3054	9.6	56.6	11.8	19.5	22.7	7.7
V-19565	3054	9.6	56.6	11.8	19.5	22.6	7.7
V-19604	3052	9.5	56.5	11.7	19.4	22.6	7.6
V-19558	3048	9.4	56.3	11.6	19.3	22.4	7.5
V-19627	3048	9.4	56.3	11.6	19.3	22.4	7.5

V-19603	2989	7.3	53.3	9.4	16.9	20.0	5.4
V-19596	2960	6.2	51.8	8.3	15.8	18.9	4.4
V-19591	2959	6.2	51.8	8.3	15.8	18.8	4.3
V-19590	2954	6.0	51.5	8.1	15.6	18.6	4.2
V-19568	2948	5.8	51.2	7.9	15.3	18.4	4.0
V-19618	2925	5.0	50.0	7.1	14.4	17.5	3.1
V-19557	2913	4.6	49.4	6.6	14.0	17.0	2.7
V-19598	2880	3.4	47.7	5.4	12.7	15.7	1.6
V-19620	2870	3.0	47.2	5.0	12.3	15.3	1.2
V-19588	2849	2.3	46.1	4.3	11.5	14.4	0.5
LSD (0.05)=395.10, CV (%)=10.04							

Regular wheat yield trial (B-Trial)

This year, 135 advance lines of bread wheat were tested in nine trials conducted under three conditions i.e. normal and late planting irrigated; and rainfed conditions. Trials were planted with plot size of 6m x 1.62m using RCB design with three replications and harvested plot size was 5m x 1.62m. Each Normal trial consisted of 15 test entries/lines with 3 check varieties (FSD-08, Anaj-17 and Akbar-17). Twenty five promising lines that performed superiorly were promoted for evaluation in provincial uniform wheat yield trials are given in Table15 with their respective data of days to 50 % heading, days to maturity, plant height, lodging %age, disease reaction and grain yield.

Table 15: Yield Performance and Related Traits of Promising Lines in Regular Yield Trials

Sr. No.	Variety Code	Parentage/Pedigree	Disease Reaction 2019-20	Lr	Yr
1	V-18352	WBLL1*2/BRAMBLING/4/BABAX/LR42//BABAX*2 /3/SHAMA*2/5/PBW343*2/KUKUNA*2//FRTL/PIFED CMSS11Y01216T-099TOPM-099Y-099M-099NJ-099NJ-12WGY-0B	4531	5MRMS	10MR
2	V-18372	BORL14//KFA/2*KACHU CMSS11B00167S-099M-0SY-25M-0WGY	5268	0	40MR MS
3	V-18381	PBW343*2/KUKUNA*2//FRTL/PIFED/3/KFA/2*KACHU CMSS11B00190S-099M-099NJ-099NJ-50WGY-0B	4976	5MRMS	10MR
	Check	FSD-08	3940		
	Check	Anaj-17	4556		
	Check	Akbar-19	4864		
1	V-18411	ALTAR 84/AE.SQ//OPATA/3/2*WH 542/7/VEE#8// JUP/BJY/3/F3.71/TRM/4/BCN/5/KAUZ/6/MILAN/KAUZ /8/ATTILA*2/PBW65/9/BAV92//IRENA/KAUZ/3/ HUITES*2/4/CROC_1/AE.SQUARROSA (224)// KULIN/3/WESTONIA/10/WBLL1*2/BRAMBLING// KACHU CMSS11B00626T-099TOPY-099M-0SY-9M-0WGY	4558	0	40MR MS
2	V-18430	NADI/COPIO//NADI CMSS11B00910T-099TOPY-099M-099NJ-099NJ-37WGY-0B	4891	0	40MR MS
	Check	FSD-08	4214		

	Check	Anaj-17	4416		
	Check	Akbar-19	5339		
1	V-18485	KFA/2*KACHU*2//MISR 1 CMSS12Y00734T-099TOPM-099Y-099M-0SY-63M-0WGY	4790	0	5MR
2	V-18515	D67.2/PARANA 66.270//AE.SQUARROSA (320)/3/ CUNNINGHAM/4/PASTOR/SLVS/5/SUNCO/ 2*PASTOR//EXCALIBUR/6/MTRWA92.161/PRINIA /5/SERI*3//RL6010/4*YR/3/PASTOR/4/BAV92 CMSA10M00288T-050Y-050ZTM-0SY-33M-0WGY	4813	0	40MR MS
	Check	FSD-08	4181		
	Check	Anaj-17	4446		
	Check	Akbar-19	5346		
1	V-18594	WBLL1*2/BRAMBLING/4/BABAX/LR42//BABAX*2/3/ SHAMA*2/5/PBW343*2/KUKUNA*2//FRTL/PIFED CMSS11Y01216T-099TOPM-099Y-099M-099NJ-099NJ- 6WGY-0B	5438	0	10R MR
2	V-18465	FRNCLN/BECARD//KACHU/KINDE CMSS12Y00141S-099Y-099M-0SY-7M-0WGY	4617	0	10MSS
	Check	FSD-08	4263		
	Check	Anaj-17	4545		
	Check	Akbar-19	5270		
1	V-19306	NELOKI//SOKOLL/EXCALIBUR CMSA11Y00507S-099Y-099M-099NJ-099NJ-10WGY-0B	5409	5MS	30MR
2	V-19307	SUP152/QUAIU #2//BECARD/QUAIU #1 CMSS11B00405S-099M-099NJ-099NJ-26WGY-0M	4823	5MRMS	0/80S
3	V-19308	BORL14//BECARD/QUAIU #1 CMSS12Y00070S-099Y-099M-0SY-9M-0WGY	5642	5MRMS	5MR
4	V-19310	SUP152/AKURI//SUP152/3/MUCUY CMSS12Y00300S-099Y-099M-0SY-4M-0WGY	5395	5MRMS	20MR
5	V-19312	BORL14*2//KFA/2*KACHU CMSS12B00633T-099TOPY-099M-0SY-12M-0WGY	5010	10MRMS	0/70MS S
6	V-19313	CNO79//PF70354/MUS/3/PASTOR/4/BAV92*2/5/HAR311/6 /BECARD/QUAIU #1/7/BECARD/QUAIU #1 CMSS12B00640T-099TOPY-099M-0SY-14M-0WGY	5214	0	10MR
7	V-19317	WBLL1//PUB94.15.1.12/WBLL1/3/MUCUY PTSS14Y00345S-0B-099Y-099B-29Y-0B	5165	0	10MR
	Check	FSD-08	4134		
	Check	Anaj-17	4288		
	Check	Akbar-19	5360		
1	V-19322	D67.2/PARANA 66.270//AE.SQUARROSA (465)/3/ 2*MUCUY PTSS14B00002T-099Y-099B-5Y-020Y	4574	5MRMS	10MR
2	V-19324	68.111/RGB-U//WARD/3/FGO/4/RABI/5/AE.SQUARROSA (784) /6/2*MUCUY PTSS14B00005T-099Y-099B-19Y-020Y	4905	0	10RMR
3	V-19325	SOKOLL/3/PASTOR//HXL7573/2*BAU*2/6/OASIS/5*BOR L95/5/ CNDO/R143//ENTE/MEXI75/3/AE.SQ/4/2*OCI CMSA10M00159T-050Y-099ZTM-099NJ-099NJ-5WGY-0B	5043	TMRMS	20MR
4	V-19332	WBLL1*2/SHAMA//BAJ#1*2/3/KACHU #1/KIRITATI// KACHU CMSS12B00720T-099TOPY-099M-0SY-11M-0WGY	5354	5MRMS	0
5	V-19334	ONIX/KBIRD//BORL14/3/ONIX/KBIRD CMSS12B00825T-099TOPY-099M-0SY-27M-0WGY	4864	5MRMS	40MR MS

	Check	FSD-08	4469		
	Check	Anaj-17	4395		
	Check	Akbar-19	5397		
1	V-19335	SUP152/AKURI//SUP152/3/MUCUY/4/MUTUS// WBLL1*2/BRAMBLING/3/WBLL1*2/BRAMBLING CMSS12B00860T-099TOPY-099M-0SY-46M-0WGY	4819	0	0
2	V-19342	FRANCOLIN #1*2/HAWFINCH #1//2*MUCUY CMSS12Y00950T-099TOPM-099Y-099M-0SY-10M-0WGY	5329	0	40MR MS
3	V-19347	BORL14*2//BECARD/QUAIU #1 CMSS12B00634T-099TOPY-099M-0SY-26M-0WGY	5341	0	0
	Check	FSD-08	4784		
	Check	Anaj-17	4514		
	Check	Akbar-19	5198		
1	V-18008	HIDHAB/ /T.DICOCCON P194625/A.SQ(372)//TUI… PB DR NO.37208-0A-0A-0A-11A	4570	0	40MR MS
	Check	FSD-08	4591		
	Check	Anaj-17	4589		
	Check	Akbar-19	5156		

Short regular wheat yield trial (B-I to B-IX)

During this year, nine B-trials of bread wheat were conducted under irrigated late sowing condition. Each trial comprises 18 advanced lines including three checks (Akbar-19, Anaj-17 and Faisalabad-08). The late sowing was done (4th December 2019) following RCB design with three replications. Data concerning yield, plant height, disease score, days to heading and maturity data was documented. On the bases of grain yield and disease reaction, 36 entries outperformed than the all three checks.

Table 16: Yield performance advanced lines in short regular yield trial 2019-20

B-1 (Short)				
V. Code	**Yield (kgha^{-1})**	**% increase over checks**		
		Akbar-19	**Anja-17**	**Fsd-08**
		4132	**3661**	**3182**
V-18350	5264	26	44	65
V-18347	5182	24	42	63
V-18313	4876	17	33	53
V-18352	4477	7	22	41
V-18372	4454	7	22	40
V-18234	4261	2	16	34
V-18381	4199	1	15	32
B-II (Short)				
		3650	6077	2753
V-18430	4331	19	56	56
V-18415	4247	16	53	53
V-18448	4242	16	52	52

V-18411	4240	16	52	52
B-III (Short)				
		4670	3656	3907
V-18449	5637	21	44	54
B-V (Short)				
		3096	4173	3783
V-19307	5075	64	22	34
V-19306	4539	47	9	20
V-19309	4211	36	1	11
V-19310	4209	36	1	11
B-VI (Short)				
		2783	4046	2984
V-19334	4608	66	14	54
V-19324	4532	63	12	52
V-19322	4252	53	5	42
V-19333	4127	48	2	38
V-19327	4125	48	2	38
B-VII (Short)				
		4091	3627	3378
V-17088	4359	29	20	29
V-19342	4268	26	18	26
V-19336	4237	25	17	25
V-19347	4682	39	29	39
V-19348	4591	36	27	36
B-VIII (Short)				
		3163	3783	3132
V-18620	4340	37	15	39
HYT-20-7	4290	36	13	37
V-19353	4249	34	12	36
V-19358	4199	33	11	34
V-19351	4165	32	10	33
V-19356	4108	30	9	31
V-18622	4022	27	6	28
V-19350	3986	26	5	27
B-IX (Short)				
		3175	5953	2818
V-18032	4168	31	5	48
V-18077	4094	29	4	45

Punjab Uniform Wheat Yield Trial (PUWYT) 2019-20

Fifty entries including three check varieties i.e. Barani-17, Fsd-08 and Johar-16 were planted at 29 locations during first fortnight of November, 2019. The best performing varieties/lines with their yields are as under,

Table 17: Yield of advance lines in Punjab uniform wheat yield trials 2019-20

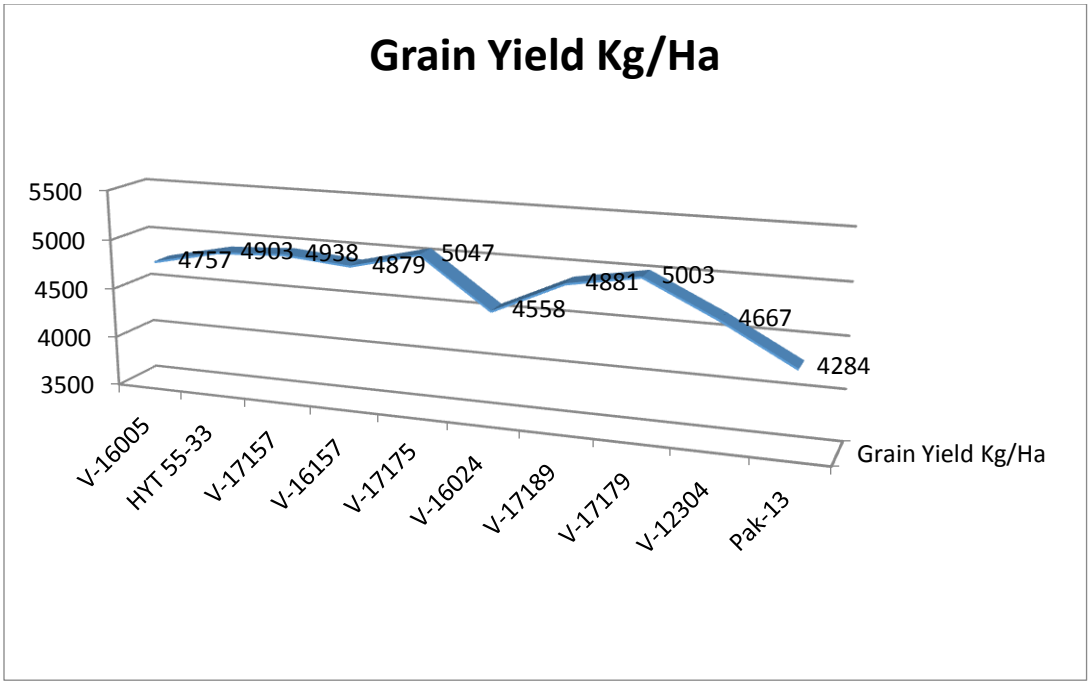
Name	Parentage	Average Kg/ha	Leaf rust ACIs	Yellow rust ACIs
HYT 70-16	**BORL14//BECARD/QUAIU#1** CMSS12Y00070S-099Y-099M-0SY-9M-0WGY	4929	1.29	17.33
HYT 70-4	**MUU/KBIRD//KACHU/KIRITATI** CMSS11B00510S-099M-099NJ-099NJ-5WGY-0M	4662	2.44	4.67
V-17086	**T.DICOCCONCI9309/AE.SQUAROSSA (409)//MUTUS/3/2*MUTUS** CMSS08Y01129T-099M-099Y-3M-0Y-5M-0Y	4576	0.77	30
V-17055	**KACHU/SAUAL/3/TACUPETO F2001/BRAMBLING//KIRITATI** CMSS10Y00372S-099Y-099M-099NJ-099NJ-23WGY-0B	4475	0	16
V-18614	**BECARD/AKURI*2/3/PBW343*2/KUKUNA*2//FRTL/PIFED** CMSS11Y01036T-099TOPM-099Y-099M-0SY-26M-0WGY	4423	0.26	3.33
HYT 70-40	**KUTZ*2/5/UP2338*2/VIVITSI/3/FRET2/TUKURU//FRET2/4/MISR 1** CMSS12Y00813T-099TOPM-099Y-099M-0SY-1M-0WGY	4395	0.13	21
HYT 70-1	**NELOKI//SOKOLL/EXCALIBUR** CMSA11Y00507S-099Y-099M-099NJ-099NJ-9WGY-0B	4393	10.41	18
V-16152	**ROLF07/SAUAL/5/SERI.1B//KAUZ/HEVO/3/AMAD*2/4/KIRITATI** CMSS10Y00359S-099Y-099M-3WGY-0B	4346	5.14	20
HYT 70-36	**PRL/2*PASTOR//KACHU** CMSS09B00260S-099M-099Y-10WGY-0B	4328	5.79	38
HYT 20-4	**KACHU/SAUAL*2/6/CNO79//PF70354/MUS/3/PASTOR/4/BAV92*2/5/FH6-1-7** CMSS11Y00827T-099TOPM-099Y-099M-0SY-14M-0WGY	4323	0.13	45

V-17065	**SAUAL/MUTUS*2//PICAFLOR #1** CMSS10B01043T-099TOPY-099M-099NJ-099NJ-20WGY-0B	4312	4.37	39
V-17053	**BABAX/LR42//BABAX/3/ER2000/8/BOW/VEE/5/ND/VG9144//KAL/BB/3/YACO/4/CHIL/6/CASKOR/3/CROC_1/AE.SQUARROSA (224)//OPATA/7/PASTOR//MILAN/KAUZ/3/BAV92** CMSA11Y00313S-099Y-099M-099NJ-099NJ-14WGY-0B	4312	0.64	54
V-18621	**SITE/MO//PASTOR/3/TILHI/4/MUNAL #1/5/MUNAL/6/MUCUY** CMSS11B00540S-099M-0SY-15M-0WGY	4293	0	60
V-18623	**NELOKI//SOKOLL/EXCALIBUR** CMSA11Y00507S-099Y-099M-099NJ-099NJ-19WGY-0B	4291	4.5	29
V-16128	**FRNCLN*2/BECARD** CMSS09Y00838T-099TOPM-099Y-099M-099Y-4WGY-0B	4266	-	-
V-17262	**BAJ # 1/3/ TRCH/SRTU// KACHU** CMSS10Y00030S-099Y-099M-099NJ-099NJ-2WGY-0B	4249	0	19
V-18097	**KFA/5/REH/HARE//2*BCN/3/CROC_1/AE.SQUARROSA(213)//PGO/…** CMSS11Y01221T-099TOPM-099Y-099M-099NJ-099NJ-17WGY-0B	4228	0	50
HYT 70-20	**SUP152/BAJ#1//KFA/2*KACHU** CMSS12Y00244S-099Y-099M-0SY-14M-0WGY	4198	0	31.5
V-17259	**TRCH/SRTU/ KACHU/3/ TRCH/SRTU// KACHU** CMSS10Y00474S-099Y-099M-099NJ-099NJ-16WGY-0B	4150	14.14	32
HYT 20-9	**CNO79//PF70354/MUS/3/PASTOR/4/BAV92*2/5FH6-17/7/SAUAL*2/6/CNDO/R143//ENTE/MEXI_2/3/AEGILOPS SQUARROSA…** CMSS11Y01144T-099TOPM-099Y-099M-099NJ-099NJ-38WGY-0B	4121	25.07	48
HYT 70-3	**SUP152*2/TECUE#1//FRNCLN*2/TECUE#1** CMSS11B00465S-099M-099NJ-099NJ-24WGY-0M	4109	1.93	27

V-18103	**BECARD/FRNCLN/3/KACHU #1/KIRITATI//KACHU** CMSS11B00426S-099M-099NJ-099NJ-3WGY-0B	4051	30.86	54
V-16144	**BECARD/6/FRET2*2/4/SNI/TRAP#1/3/KAUZ *2/TRAP//KAUZ*2/5/BOW/URES//2*WEAVE R/3/CROC_1/AE.SQUARROSA (213)//PGO** CMSS09B00382S-099ZTM-099NJ-099NJ-18WGY-0B	3975	19.93	32
V-18106	**NADI/COPIO//NADI** CMSS11B00910T-099TOPY-099M-099NJ-099NJ-37WGY-0B	3860	37	69
Barani-17	**Check variety**	4066	-	-
Fsd-08	**Check variety**	3894	-	-
Jouhar-16	**Check variety**	3797	-	-

National Uniform Wheat Yield Trial (NUWYT) 2019-20

The advanced lines contributed by WRI, Faisalabad and their grain yield is presented below Viz;V-16005 (4757 kg ha^{-1}), HYT 55-33 (4903 kg ha^{-1}), V-17157 (4938 kg ha^{-1}), V-16157 (4879 kg ha^{-1}), V-17175 (5047 kg ha^{-1}), V-16024 (4558 kg ha^{-1}), V-17189 (4881 kg ha^{-1}), V-17179 (5003 kg ha^{-1}), V-12304 (4667 kg ha^{-1}) while check variety Pak-13 yielded 4284 kg ha^{-1} all over Punjab.



INTERNATIONAL NURSERIES/TRIALS

Evaluation of 40th Elite spring wheat yield trial (40TH ESWYT)

The 40th ESWYT comprising of 50 entries including local check variety Faisalabad 08 was sown in two replication with plot size of 5m*6 rows on 27-11-2019 keeping row to row distance 27cm. Thirteen entries performed better than check.

Table 18: Yield performance of selected entries in 40th elite spring wheat yield trial (40TH ESWYT)

Entry	D/H	PH	Lr	Yr	1000 Grain wt (g)	Grain yield (g/plot)	Yield (Kg/hac)
104	95	80	0	0	39	3400	4182
105	98	85	0	0	33.5	3705	4557.15
106	102	100	0	0	37.5	3680	4526.4
109	99	95	0	0	37.5	3745	4606.35
112	102	87	0	0	37	3430	4218.9
113	102	85	0	0	39	3440	4231.2
114	103	95	10R	0	39.5	3500	4305
116	104	90	0	0	37.5	3320	4083.6
121	103	90	0	0	37.5	3340	4108.2

123	103	95	0	0	42	3635	4471.05
128	102	85	0	0	35	3970	4883.1
129	104	90	0	0	34.5	3770	4637.1
150	102	85	0	0	39	3440	4231.2
FSD-08 (Check)	97	90	20S	30S	29.5	2200	2706

Evaluation of 27th Semi-arid wheat yield trial (27TH SAWYT)

The 27th SAWYT comprising of 50 entries were sown in two replication with plot size of 5m*6 rows on 27-11-2019. Out of 50 entries 12 genotypes were disease free and gave higher yield than local check variety Faisalabad 08.

Table 19: Yield performance of selected entries in 27th Semi-arid wheat yield trial (27TH SAWYT)

Entry	D/H	D/M	PH	Lr	Yr	1000 Grain wt (g)	Grain yield (g/plot)	Yield (Kg/hac)
304	106	138	90	0	0	44	3690	4538.7
306	98	137	85	0	0	42.5	3330	4095.9
310	103	136	90	0	0	38	3320	4083.6
313	104	134	95	0	0	41	3315	4077.45
315	104	134	95	TRR	0	40	3505	4311.15
328	102	134	85	0	0	38.5	3355	4126.65
329	103	134	85	0	0	37	3440	4231.2
331	99	142	95	0	0	37.5	3380	4157.4
332	102	138	80	0	0	39.5	3475	4274.25
333	102	137	85	0	0	37.5	3440	4231.2
346	104	142	90	0	0	38	3460	4255.8
350	98	133	90	0	0	32.5	3630	4464.9
Fsd-08 (Check)	97	135	86	30S	0	31	2475	3044

Evaluation of 7TH Wheat yield consortium yield trial (7th WYCYT)

The 7th WYCYT comprising of 35 entries were sown in two replication with plot size of 5m*6 rows on 27-11-2019. Out of 35 entries 12 entries gave higher yield than check.

Table 20: Yield performance of selected entries in 7TH Wheat yield consortium yield trial (7th WYCYT)

Entry	D/H	D/M	PH	Lr	Yr	1000 Grain wt (g)	Grain yield (g/plot)	Yield (Kg/hac)
11	102	139	95	10S	TMR	47.9	3445	4237.35
12	104	141	92	5S	0	39.8	3340	4108.2
29	104	140	88	5R	0	35.9	3360	4132.8
FSD-08 (Check)	102	135	84	10S	10R	27.3	2385	2933

Evaluation of 2nd collaborative wheat yield trial (2nd CWYT)

The 7th CWYT comprising of 50 entries were sown in two replication with plot size of 5m*6 rows on 27-11-2019 keeping row to row distance 27cm. On the basis of result 7 entries were selected and given in the table below:

Table 21: Yield performance of selected entries in 2nd collaborative wheat yield trial (2nd CWYT)

Entry	D/H	D/M	PH	Lr	Yr	1000 Grain wt (g)	Grain yield (g/plot)	Yield (Kg/hac)
603	103	137	92	0	0	33.5	3180	3243.6
607	105	141	88	0	0	31.3	3110	3172.2
609	105	135	86	0	0	34.1	3140	3202.8
615	107	139	95	0	15S	36.2	3420	3488.4
618	107	137	98	0	0	47	3435	3503.7
624	107	140	92	0	0	34.3	3155	3218.1
625	105	141	94	20S	0	34.4	3205	3269.1
FSD-08 (Check)	110	141	94	40S	30S	30.8	1860	1897

Evaluation of 52nd INTL. BREAD WHEAT SECREENING NURSERY (52ND IBWSN)

The 52nd IBWSN comprising of two hundred eighty four entries including local check Faisalabad 08 was sown in 2m*2 row on 22-11-2019. Out of 284 entries 75 genotypes gave higher yield than local check. Some of higher yielder enlisted in the table.

Table 22: Yield performance of selected entries in 52nd IBWSN during 2019-20

Entry	D/H	D/M	PH	Lr	Yr	1000 Grain wt (g)	Grain yield (g/plot)	Yield (Kg/hac)
1064	103	141	85	0	0	40	794	6614
1082	105	141	85	10M	0	40	775	6455
1206	105	140	85	5M	0	41	762	6347
1199	107	142	85	20M	TRR	35.8	753	6272
1163	104	140	75	5M	0	40.5	737	6139
Fsd-08 (Check)	102	138	85	50S	0	30.5	381	3173

Remaining top yielder genotypes were

E-1013, 1020, 1023, 1024, 1027, 1032, 1033, 1034, 1038, 1040,1044,1046,1047,1048, 1051,1052,1058,1065,1067,1068,1069,1070,1071,1073,1074,1076,1079,1081,1087,1090,1095, 1097,1099,1103,1107,1108,1114,1118,1120,1122,1123,1127,1131,1132,1133,1137,1145,1147,1154,1160,1162,1163,1167,1168,1189,1192,1194,1211,1221,1226,1236,1238,1242,1241,1263,1265,1273,1274,1280 and 1281 with grain yield ranging from 600 to 700 genotypes.

Evaluation of 9th stress adaptive trait yield nursery (Drought trial) (9TH SATYN DT)

9TH SATYN comprising of 30 entries were sown in two replications with plot size of 5m*6 rows on 25-11-2019.No irrigation was applied to this trial except rouni water. Ten resistant and high yielding lines were ear marked mentioned below:

Table 23: Yield Performance of Selected Entries In 9th Satyn During 2019-20

Entry	D/H	D/M	PH	Lr	Yr	1000 Grain wt (g)	Grain yield (g/plot)	Yield (Kg/hac)
9440	109	133	95	TMR	TMR	37.5	4050	3750
9422	105	141	85	0	TR	36.5	4029	3730
9420	102	142	95	TM	10S	36	3850	3564
9425	105	141	95	10S	5MR	36.5	3827	3543
9418	105	141	96	TMR	5R	37	3586	3320
9424	106	141	90	0	TMR	30.5	3520	3259
9423	107	142	85	0	0	35	3513	3252
9405	103	139	85	10S	10S	35	3500	3240
9404	104	139	95	0	20MRM	38	3480	3222

					S			
9409	105	140	95	5S	10S	39	3450	3194
Fsd-08 (Check)	98	135	75	0	80S	26.5	2465	2282

18th HIGH TEMPERATURE WHEAT YIELD TRIAL

The 18th HTWYT comprising of 50 entries including local check variety Faisalabad-08 was planted in duplicate on 25th November, 2019. On the basis of the result, following entries performed well.

Table 24: Yield performance of selected entries from 18th HTWYT

E. No.	Days to 50% Heading	Plant Height (cm)	LR	YR	1000 K.W.	Grain Yield (g/plot)	Grain Yield ($kgha^{-1}$)
4	102	86	0	0	37.4	3.92	4821
5	102	82	0	0	41.0	3.12	3837
14	105	81	0	0	34.2	3.09	3800
15	102	79	TR	0	34.2	3.43	4218
29	102	90	TS	0	31.1	3.66	4501
30	101	85	0	0	31.6	3.81	4686
32	102	86	TR	0	35.8	3.76	4624
35	103	91	0	0	35.4	3.19	3923
36	102	82	0	TMS	35.1	3.45	4243
37	105	87	0	0	35.4	3.30	4059
42	103	85	TS	0	33.5	3.41	4194
50	104	111	10S	TS	34.4	3.57	4391

37th Semi-Arid Wheat Screening Nursery (SAWSN)

Two hundred and eighty three entries along with the check variety Barani-17 were tested. One hundred and eight lines performed better than the check variety for further evaluation. The top ten best performing lines are given in the table as under;

Table 25: Best Performing Lines in Semi-Arid Wheat Screening Nursery SAWSN)

Genotype	code	Yield (Kg ha^{-1})	Lr	Yr
FRANCOLIN#1//WBLL1*2/BRAMBLING/4/WBLL1*2/KURUKU*2/3/KIRITATI//PBW65/2*SERI.1B/5/MUTUS/AKURI	3034	6116	10M	5M
MUCUY/BORL14//MUCUY	3139	5669	0	0
MACE/5/TILILA/JUCHI/4/SERI.1B//KAUZ/HEVO/3/AMAD/6/KACHU/BECARD//WBLL1*2/BRAMBLING	3193	5476	0	0
ATTILA*2/PBW65*2//MURGA/3/KACHU/KIRITATI	3084	4795	0	0
ALTAR 84/AE.SQUARROSA (221)//3*BORL95/3/URES /JUN//KAUZ /4/ WBLL1 /5/MUTUS/6/SUP152/BAJ #1	3094	4655	0	0
ALTAR 84/AE.SQUARROSA (221)//3*BORL95/3/URES/JUN// KAUZ/4/WBLL1 /5/MUTUS/6/SUP152/BAJ #1	3098	4649	0	0
WBLL1*2/CHAPIO*2//MURGA/3/MUTUS/AKURI	3087	4609	0	0
ATTILA*2/PBW65*2//MURGA/3/KACHU/KIRITATI	3083	4582	0	0
BOKOTA//FRNCLN*2/TECUE #1	3093	4548	0	0
HUIRIVIS #1/MUU//WBLL1*2/BRAMBLING/3/TRCH/HUIRIVIS #1/4/HUIRIVIS #1/MUU//WBLL1*2/BRAMBLING	3078	4528	0	0
Barani-17	Check	3150		

51st International Durum Yield Nursery

During 2019-20, 51st International Durum Yield Nursery was received from CIMMYT. 11 lines out of 50 lines were selected on the basis of yield and their performance against diseases. The line E-742 had the highest yield (3656 g/plot) followed by E-718 (3382 g/plot) and E.743 (3130 g/plot). The yield of Durum-97 (check) was 2053 g/plot.

51st International Durum Screening Nursery

During 2019-20, 51st International Durum Screening Nursery was received from CIMMYT. 35 lines out of 177 lines were selected on the basis of their performance against diseases and 1000-grain weight. The line E- 7100, E-7110 and E-7136 gave the highest 1000-grain weight (39.80, 39.60 & 39.0 g). The 1000-grain weight of Durum-97 (check) was 37.32g.

21st Karnal Bunt Screening Nursery

The 21st KBSN comprising of 32 entries including local check variety Morocco was sown on 7th November, 2019. On the basis of the results, following entries performed well.

Table 26 : Yield performance of selected entries from 21st KBSN

E. No.	LR	YR	Days to 50% Heading	Plant Height (cm)	1000 K.W.	Grain Yield (g/plot)	Grain Yield ($kgha^{-1}$)
4	0	0	102	86	35	920	6136
5	0	0	110	100	34	1220	8137
7	0	0	107	85	37	1000	6670
8	5MSS	0	102	88	37	1020	6803
10	0	0	108	92	35	1110	7403
12	0	0	111	100	33	920	6136
16	0	0	103	90	40	970	6469
20	0	0	107	88	33	1055	7036
22	0	0	110	80	38	960	6403
27	0	0	110	95	40	905	6036
29	0	0	110	94	35	920	6136

29th International Septoria Observation Nursery

The 29th ISEPTON comprising of 53 entries including local check variety Akbar-19 and Fsd-08 was sown on 7th November, 2019. On the basis of the results, following entries performed well.

Table 27: Yield performance of selected entries from 29th ISEPTON

E. No.	LR	YR	Days to 50% Heading	Plant Height (cm)	1000 K.W.	Grain Yield (g/plot)	Grain Yield ($kgha^{-1}$)

6207	0	0	112	85	33	910	6069
6208	0	0	109	90	32	910	6069
6222	0	0	109	95	36	960	6403
6229	0	0	111	80	33	1055	7036
6230	0	0	115	75	35	945	6303
6248	20M	0	109	100	40	915	6103
6249	10M	0	105	105	38	1085	7236
6250	0	5M	106	85	34	1010	6736

SOUTH ASIA BREAD WHEAT GENOMIC PREDICT YIELD TRIALS 2019-20

This year 600 lines were evaluated in ten trials. Trials were planted following Alpha Lattice Design with two replications and harvested plot size was 8.1 m^2. Each trial consisted of 59 test lines with check variety (Faisalabad-08). Ninety seven (97) promising lines were selected from candidate lines received from CIMMYT for further study in regular yield trials. The yield performance of top five high yielding lines compared to check variety is given below.

Table 28: Yield performance of top five high yielding lines in SABWGPYT 2019-20

Entry No.	Parentage	Yield (kg/ha)	Leaf Rust	Yellow Rust	% increase over Faisalabad-08
2037	PRL/2*PASTOR*2//FH6-1-7/3/2*ATTILA*2/PBW65//MURGA	6900	0	10MR	20.08
7013	MUCUY*2/BORL14	6888	0	5MR	19.87
9019	SEHER 06/MUCUY	6833	5MR	5M	18.92
9043	KFA/2*KACHU*2//MUTUS*2/CHONTE	6679	TR	5MR	16.24
9045	KFA/2*KACHU*2/3/PAKHWA*2//KIRITATI/2*TRCH	6646	TMR	0	15.66
Check	FAISALABAD-08	5746	40S	20MSS	-

International Trials

10th Harvest Plus Yield Trial 2019-20

10th Harvest Plus Yield Trial was received from CIMMYT. Fifty entries of this trial were planted in two replications on November 18, 2019. Twenty (20) lines out of 50 were selected on

the basis of yield and their performance against diseases. The line E-435 had maximum grain yield (5128 kg/ha) followed by E-415 (4839 kg/ha) and E-404 (4805 kg/ha) against the check variety Faisalabad-08 (3284 kg/ha). The grain analysis of these 50 lines for zinc contents and other quality parameters are under process and further selection will be made on the basis of this analysis. The performance of selected lines is given in the table-

Table-29 Performance of selected lines from 10th Harvest Plus Yield Trial 2019-20.

S.No.	Entry No.	Days to 50 % Heading	Plant Height (cm)	Disease Reaction		1000-Grain Weight (g)	Grain Yield (kg ha^{-1})
				LR	YR		
1	404	104	90	TS	TR	41.50	4805
2	409	107	90	0	TR	39.00	4426
3	412	105	90	0	TR	34.00	4537
4	414	106	90	0	0	38.75	4503
5	415	106	90	0	5MR	46.25	4839
6	416	107	100	0	0	40.00	4580
7	417	107	100	0	10MR	41.50	4395
`8	418	106	95	0	10MR	36.00	4404
9	419	106	97	0	0	44.50	4534
10	420	106	90	0	TMR	47.75	4265
11	428	99	102	0	0	38.25	4503
12	429	98	102	0	0	41.75	4311
13	431	102	100	0	5MR	42.50	4796
14	433	106	104	0	0	42.75	4472
15	435	105	97	0	0	37.75	5128
16	436	105	95	0	0	39.75	4463
17	439	107	109	0	TMR	38.75	4540
18	441	101	100	0	0	36.75	4324
19	443	105	102	0	5TMR	45.75	4370

20	447	105	95	0	TMR	40.25	4605
21	Faisalabad-08 (Check)	102	92	TS	30MR	35.50	3284

11th Harvest Plus South Asia Nursery 2019-20

The nursery of 280 lines was evaluated for different parameters along with check varieties (Ujala-16 and Akbar-19). Fifty (50) high yielding and disease resistant lines were selected. The grain analysis for zinc content of these 280 lines is under process and further selection will be made on the basis of this analysis. Among these genotypes the line E-132 had maximum grain yield (5062 kg/ha) followed by E-80 (4749 kg/ha) and E-130 (4729 kg/ha) against the check varieties, Ujala-16 (3600 kg/ha) and Akbar-19 (4202 kg/ha) and showed resistance to rusts. The performance of selected lines is given in the table-.

Table 30- Performance of selected lines from 11th Harvest Plus South Asia Nursery 2019-20

Sr#	Entry No.	Days to 50 % Heading	Plant Height (cm)	1000- Grain Weight	Grain Yield (kg ha^{-1})	Disease Reaction	
						LR	YR
1	2	84	100	50.00	3909	0	0
2	10	86	100	46.00	4589	0	0
3	12	84	90	36.00	3755	0	0
4	13	83	92	40.00	3735	0	0
5	17	86	95	30.5	4042	0	TM
6	23	89	95	46.75	3915	0	0
7	24	92	90	45.25	3789	0	0
8	37	82	105	52.00	3821	0	0
9	49	87	90	41.25	3915	0	TM
10	62	84	75	47.50	3608	0	0
11	79	90	80	48.00	4482	0	TM
12	80	87	95	53.25	4749	0	TR
13	103	86	95	43.50	3735	0	10M
14	111	91	85	51.75	3628	0	0
15	113	82	95	51.50	3795	0	0
16	114	84	75	51.25	3748	0	0
17	115	89	85	51.50	4015	0	TR
18	122	87	95	51.00	3622	0	0
19	126	85	85	54.25	3749	0	0
20	129	89	95	49.50	4175	0	0
21	130	84	90	49.50	4729	0	0
22	131	86	85	48.00	3922	0	0

23	132	86	90	52.75	5062	0	0
24	137	92	95	45.75	4315	0	0
25	144	88	95	36.25	3695	0	0
26	151	83	85	41.25	4422	0	5M
27	152	85	80	45.00	3902	0	TM
28	155	89	90	37.75	4102	0	0
29	158	90	90	40.50	3635	0	0
30	160	86	95	45.75	3815	0	0
31	166	87	90	44.25	3942	0	TR
32	170	84	105	45.50	4389	0	0
33	177	88	100	34.75	3889	0	5M
34	181	87	95	36.50	3715	0	5M
35	186	88	95	34.25	3769	0	0
36	210	89	80	38.25	3762	0	0
37	212	90	95	44.50	3802	0	0
38	218	86	95	40.50	3722	0	0
39	222	85	100	34.25	3735	0	TR
40	224	86	90	43.50	3802	0	5M
41	227	89	90	36.75	3949	0	TR
42	228	88	95	43.00	3975	0	5M
43	230	87	95	36.00	3602	0	0
44	231	86	90	40.00	3835	0	0
45	233	86	90	40.75	3835	0	0
46	240	85	90	40.00	3862	0	0
47	255	86	90	38.25	3689	0	TR
48	263	90	100	35.75	3669	0	0
49	267	86	85	32.25	3762	0	0
50	273	86	85	49.25	3615	0	0

9th Harvest Plus Yield Trial 2018-19

During 2018-19, 9th Harvest Plus Yield Trials were received from CIMMYT. Fifty entries of this trial were planted in two replications. Nineteen (19) lines out of 50 were selected on the basis of yield and their performance against diseases. The line E-443 had the highest grain yield (5744 kg/ha) followed by E-441 (5258 kg/ha) and E-448 (5208 kg/ha) against the check variety Galaxy-2013 (3600 kg/ha). The grain analysis of these 50 lines for Zinc contents and other quality parameters is under process and further selection will be made on the basis of this analysis. The performance of selected lines is given in the table-27

Table 31:Performance of selected lines from 9th Harvest Plus Yield Trial

S. No.	Entry No.	Days to 50 % Heading	Plant Height (cm)	Disease Reaction		1000 Grain Weight (g)	Grain Yield (kg ha^{-1})
				LR	YR		
1	403	103	114	0	0	35.4	4910
2	409	106	111	0	0	39.4	4604
3	410	108	107	0	0	38	4493
4	412	108	109	0	0	42	4792
5	414	108	108	0	0	37.6	4469
6	416	103	113	0	0	36.8	4913
7	419	105	104	0	0	41.8	5032
`8	423	108	114	0	0	36.8	4437
9	427	102	106	0	5MR	36.4	4773
10	431	109	110	0	0	37.2	4617
11	432	104	110	0	0	40.4	4691
12	433	102	110	0	0	36.6	4667
13	435	108	107	0	0	31.6	4490
14	440	106	105	0	0	37	4778
15	441	105	108	0	0	51.8	5258
16	442	102	116	0	0	43.2	5167
17	443	105	108	0	0	37.8	5744
18	446	107	118	0	0	40	4713
19	448	104	103	0	0	40.8	5208
20	Galaxy-13 (Check)	107	105	0	50M	26.6	3600

10th Harvest Plus South Asia Nursery 2018-19

230 lines were evaluated for different parameters along with check variety (Punjab-11). Fifty (50) high yielding and disease resistant lines were selected. The grain analysis for Zinc content of these 230 lines is under process and further selection will be made on the basis of this analysis. The entries 195, 89, 4, 56 and 93 produced maximum grain yield i.e. 5870 kg/ha, 5623 kg/ha, 5136 kg/ha, 4982 kg/ha and 4936 kg/ha respectively and showed resistant to rusts. The performance of selected lines is given in the table-28

Table 32: Performance of selected entries from 10th Harvest Plus South Asia Nursery

Sr#	Entry No.	Days to 50 % Heading	Plant Height (cm)	1000- Grain Weight	Grain yield (kg ha^{-1})	Disease Reaction	
						LR	YR
1	4	100	104	34.6	5136	0	TMR
2	5	102	107	47	4822	0	0
3	6	105	95	35.8	4882	0	0

4	13	105	110	37.8	4262	0	0
5	36	102	93	28.8	3762	0	0
6	38	104	98	32.4	4516	0	0
7	40	103	92	33	4756	0	TMR
8	46	103	104	32.6	4769	0	TM
9	54	105	94	33	4369	0	0
10	56	101	103	34	4982	0	0
11	62	101	105	37.6	4756	0	TMS
12	64	105	106	38	4642	0	0
13	65	104	103	37.8	3922	0	TMS
14	68	100	100	38.4	3809	0	0
15	69	101	107	43	3969	0	TMR
16	76	101	95	35.4	3902	0	TMR
17	78	104	95	36.2	3835	0	0
18	80	104	91	32	3755	0	0
19	85	104	97	33.8	4275	0	0
20	86	105	108	28.6	4649	0	0
21	89	100	103	37.4	5623	0	TM
22	92	105	100	31.4	4182	0	TMR
23	93	104	107	35.6	4936	0	0
24	97	103	106	30.6	4029	0	TM
25	122	100	100	34.6	4322	0	0
26	135	102	103	32	4002	0	0
27	153	103	83	32.6	4122	0	0
28	163	102	90	33.8	4135	0	TMR
29	164	105	102	29	3962	0	TM
30	166	100	99	36	4182	0	TMS
31	167	101	93	34.4	3735	0	TMS
32	169	99	106	44.6	3909	0	0
33	170	103	100	38.8	4049	0	0
34	172	104	97	37.2	4636	0	0
35	173	102	104	32.2	3942	0	0
36	183	101	101	36.4	4309	0	TMR
37	185	101	92	32.8	4049	0	0
38	186	103	93	35	4502	0	0
39	188	101	95	31.6	3802	0	0
40	189	100	110	39	4069	0	TM
41	190	101	102	36.4	3935	0	TMR
42	193	102	107	38.2	4589	0	TM
43	195	101	103	43.6	5870	0	TM
44	201	103	107	35.5	4456	0	0
45	202	104	97	33.2	3822	0	0
46	210	101	102	35.8	3802	0	0
47	217	103	104	33.8	3875	0	0

48	222	101	98	32	4029	0	0
49	223	105	107	29.4	3875	0	TMR
50	229	106	109	28.8	4009	0	TMS

STATION YIELD TRIALS

i. Regular Yield Trial (B-Trial) 2019-20

Eighteen advance lines along with two check varieties (Zincol-16 & Anaj-17) were evaluated for different parameters at three locations of Punjab. The average yield performance of top three lines is given in table-

Table 33- Performance of selected lines from Regular Yield Trial 2019-20

Variety code	Grain Yield (kg ha^{-1})	Leaf Rust	Yellow Rust	% increase over check varieties	
				Anaj-17	Zincol-16
V-19435	3825	0	TMR	3.51	12.10
V-19429	3782	0	TMR	2.35	10.84
V-19431	3707	0	TMR	0.32	8.64
Anaj-17	3695	TR	5R	-	-
Zincol-16	3412	TR	10R	-	-

ii. Preliminary Yield Trial (A-Trial) 2019-20

Eighteen (18) entries out of forty-eight were selected on the basis of high yield and disease resistance and will be promoted to Regular Yield Trial after the grain analysis. The line V- 19397 produced maximum grain yield (4349 kg/ha) followed by V-19405 (4216 kg/ha) and V-19385 (4204 kg/ha) against the check varieties Punjab-11 (3571 kg/ha) and Zincol-16 (4068 kg/ha). The grain analysis of these 50 lines for zinc contents and other quality parameters are under process and further selection will be made on the basis of this analysis.

The performance of selected lines is given in the table-

Table 34- Performance of selected lines from Preliminary Yield Trial 2019-20

S.No.	Variety code	Days to 50 % Heading	Disease Reaction		1000 Grain Weight (g)	Grain Yield (kg ha^{-1})
			LR	YR		
1	V-19371	104	0	5MR	33.75	4117
2	V-19373	106	0	TMR	41.00	3938
3	V-19374	109	0	TMR	40.25	3966
4	V-19379	100	0	TMR	39.00	3947
5	V-19385	102	0	TMR	39.5	4204

6	V-19386	103	0	5MR	40.5	3987
7	V-19391	110	0	10MR	39.25	3950
`8	V-19395	106	0	0	33.5	4182
9	V-19397	102	0	TR	39.25	4349
10	V-19400	106	0	TR	37.25	4070
11	V-19401	106	0	0	31.75	3987
12	V-19402	109	0	TR	30.25	4117
13	V-19405	100	0	10MR	35.25	4216
14	V-19408	105	0	0	34.25	3997
15	V-19409	108	0	TR	35.25	3938
16	V-19412	106	0	TR	39.25	3939
17	V-19414	103	0	TR	35.00	3957
18	V-19415	109	0	TR	31.25	3929
19	Punjab-11 (Check)	103	20S	5MR	30.25	3571
20	Zincol-16 (Check)	103	TMR	TR	40.25	4068

WHEAT AGRONOMY

Effect of climate change on sowing time of wheat crop

The trial was conducted to find out the best sowing time for newly developed wheat lines under changing climate scenario. Ten newly developed wheat lines viz. V-16005, V-17179, V-17175, V-16157, V-17157, V-17189, V-16024,V-16164 , V-12304 and HYT-55-33 along with four check varieties i.e. Fsd-08, Ujala-16, Anaj-17 and Akbar-19 were planted seven times starting from 20th October to 30th December with ten days interval. Maximum grain yield of 4694kg ha^{-1} and 4564 kg ha^{-1} was recorded when crop was sown on 20th Oct.and 10th November respectively on overall mean basis which was followed by 1st November sown grain yield (4548 kg ha^{-1}). It was found that HYT-55-33 produced maximum grain yield (4428 kg ha^{-1}) amongst all varieties, followed by V-17179 (4405 kg ha^{-1}) and V-17189 (4378 kg ha^{-1}).

Table 37: Effect of planting time on grain yield of wheat varieties

Advanced lines/ Varieties	20th Oct.	1st Nov.	10th Nov.	20th Nov.	30th Nov.	10th Dec.	20th Dec.	30th Dec.	Mean
Fsd-08	3380	4525	3723	3913	2999	2735	2838	2834	3368f
Ujala-16	4777	4024	3675	3092	3308	3227	3128	3129	3545ef
Anaj-17	5129	4472	4429	4124	3642	3620	3423	3359	4025c
Akbar-19	5264	4782	4909	3795	3654	3599	3580	3455	4130bc
V-16005	4921	4655	5256	4491	3846	3774	3731	3414	4261ab
V-17179	4979	5144	5268	4367	4272	3899	3681	3629	4405a
V-17175	4427	4709	4736	4206	3833	3692	3659	3479	4093bc
V-16157	4264	4247	4685	3860	3573	3731	3625	3364	3919cd
V-17157	3935	3885	3987	3731	3757	3678	3697	3181	3731de
V-17189	5108	4621	4957	4427	4030	4030	3863	3990	4378a
V-16024	4468	4110	4619	3681	3822	3784	3198	3668	3919cd
V-16164	4439	4714	4400	4165	3831	3750	3633	3575	4063bc
V-12304	5244	4837	4321	3582	3613	3888	3597	3700	4098bc
HYT-55-33	5384	4943	4940	4434	4006	4031	3915	3771	4428a
Mean	4694a	4548b	4564ab	3991c	3727d	3674de	3541ef	3468f	
Cd1 for sowing dates135.10, for varieties 220.53 and for interaction 615									

Response of seed rate on grain yield of advanced wheat lines

Seven advanced lines i.e. V-16005, V-16157, V-17175, V-17179,V-17157, V-17189 and HYT-55-33 with one check variety viz. Fsd-08 were tested along with four seed rates. Viz. 75, 100, 125, 150 kg ha^{-1} were tested. Maximum grain yield of 4788 kg ha^{-1} was recorded when 100 kg ha^{-1} seed rate was used which differed statistically from 75, 125 and 150 kg ha^{-1} seed rates producing grain yield of 4245, 4662 and 4485 kg ha^{-1}, respectively. Advanced line V-17179 gave maximum yield of 4952 kg ha^{-1}.

Table 35: Effect of Seed Rate on Grain Yield of different wheat varieties/lines

Advanced lines/ Varieties	Seed rate (kg ha^{-1})				Mean Yield Kg hac^{-1}
	75	100	125	150	
Fsd-08	**4139**	**4480**	**4350**	**4191**	**4290cd**
V-16005	**4782**	**5029**	**4866**	**4760**	**4859ab**
V-16157	**3824**	**4525**	**4325**	**3836**	**4127d**
V-17175	**3937**	**4803**	**4906**	**4698**	**4586abc**
V-17179	**4566**	**5266**	**5110**	**4866**	**4952a**
V-17157	**4114**	**4539**	**4511**	**4499**	**4416bcd**

V-17189	**4191**	**4837**	**4529**	**4433**	**4497bcd**
HYT-55-33	**4405**	**4823**	**4698**	**4599**	**4631abc**
Mean	**4245c**	**4788a**	**4662ab**	**4485b**	
Cd_1 for varieties 452, for seed rates 226 and for V×S 641					

Response of Fertilizer on grain yield of advanced wheat lines

The trial was conducted on mid-November to explore optimum fertilizer requirement of Seven advanced lines i.e. V-16005, V-16157, V-17175, V-17179,V-17157, V-17189 and HYT-55-33 with one check variety viz. Fsd-08 along with four NPK levels (0-0-0, 90-60-60, 120-90-60, 150-120-60) kg ha^{-1}. The Maximum grain yield of 4677 kg ha^{-1} was recorded where NPK fertilizer was applied @ 120-90-60 kg ha^{-1} which was statistically different from 150-120-60 NPK kg ha^{-1} (4306 kg ha^{-1}). Among the advanced lines, V-17179 gave the maximum yield of 44678 kg ha^{-1}.

Table 36: Effect of different levels of fertilizer on the yield different wheat varieties/line.

Advanced lines/ Varieties	**Fertilizer levels**				
	L1 0-0-0	**L2 90-60-60**	**L3 120-90-60**	**L4 150-120-60**	**Mean Yield** (Kg hac^{-1})
Fsd-08	3342	3994	4501	4105	3985cd
V-16005	3596	4321	4475	4410	4201bc
V-16157	3258	4301	3889	3680	3782d
V-17175	3401	4921	4714	4474	4377ab
V-17179	3605	4813	5233	5060	4678a
V-17157	3585	4371	4657	4054	4167bc
V-17189	3633	4429	4649	3973	4171bc
HYT-55-33	3723	4256	5300	4690	4492ab
Mean	3518c	4426b	4677a	4306b	
Cd1 for varieties 355 , for Fertilizer rates 249.73 and for V ×F 709					

Effect of irrigation scheduling on wheat yield

Different combinations of plant stages were tested in five treatments of irrigations. In this study five different treatments of irrigations were tested along with five advanced lines alongwith one check variety i.e Fsd-08. The Maximum grain yield of 4753 kg ha^{-1} was recorded when three irrigations were applied (1st crown root, 2nd booting and 3rd at grain filling), which is not statistically differed with other treatments of two irrigations (1st crown root and 2nd at booting stage) producing grain yield of 4676 kg ha^{-1}. Among varities V-17179 and HYT-55-33 gave the maximum grain yield of 4933 kg ha^{-1} and 4857 kg ha^{-1} respectively.

Table 37: Effect of irrigation scheduling on different growth stages of wheat

Varieties	T_1 No irrigation	T_2 one irrigation at CRS	T_3 two irrigations (CRS+Booting)	T_4 three irrigations(CRS+ Booting+G.F)	T_5 three irrigations (CRS+S.E +Booting+ G.F)	Mean
Fsd-08	3263	3685	4453	4637	3673	3942 c
V-16005	4009	4004	4554	4426	4453	4289b
HYT-55-33	4172	4865	4959	5228	5060	4857a
V-17179	4357	4839	5293	5460	4715	4933a
V-17175	3421	4342	4475	4244	4141	4124 bc
V-16157	3939	4350	4319	4524	4155	4257b
Mean	3860d	4347c	4676ab	4753a	4366bc	
Cd_1 for varieties 323.40, for irrigation 255.67 and for V×I 571						

Bio-fortification of wheat through application of Iron and Zinc.

Six treatments with different combinations (soil and foliar application) of Iron and Zinc along with control were tested. Maximum grain yield of 4518 kg ha^{-1} was recorded in T4(Foliar application combination of Zn & Fe) which statistically is not differed with T7(soil application of combination of Zn and Fe)was applied i.e 4403. Minimum grain yield of 3749 kg ha^{-1} was recorded in T1(control).

Table 38: **Bio-fortification of wheat through application of Iron and Zinc.**

Treatments	**Mean**
T_1= Control (No application of Fe & Zn)	3749 D
T_2= Foliar application of 0.5 % $ZnSO_4$	4041 BC
T_3= Foliar application of 1.0 % Fe SO_4	3940 CD
T_4= Foliar application combination of Zn & Fe	4518 A
T_5= Soil application of 10 kg Zn ha^{-1}	4156 B
T_6= Soil application of 12 kg Fe ha^{-1}	3757 D
T_7= Soil application combination of Zn & Fe	4403 A
LSD (0.05) 194	

Comparison study of conventional and resource conservation agriculture technologies for wheat crop

In this study five different treatments of resource conservation viz: zero tillage without residue, zero tillage with residue, bed planting without residue, bed planting with residue and bed planting with residue (1/2 seed rate) were tested against the conventional sowing. Maximum grain yield of 4308 kg/ha was

recorded in treatment of zero tillage with residue which is followed by Conventional sowing, bed planting with residue(1/2 seed rate), bed planting without residue, zero tillage without residue and bed planting with residue i.e. 4248, 4110, 3912, 3715 and 3676 kg/ha respectively .

Table 39. Comparison study of conventional and resource conservation agriculture technologies for wheat crop

Treatments	**Yield kg/ha.**
T1=Conventional sowing	4248
T2=Zero tillage without residue	3715
T3=Zero tillage with residue	4308
T4=Bed planting without residue	3912
T5=Bed planting with residue	3676
T6= Bed planting with residue (1/2 seed rate)	4110

Bio-Fortification Of Wheat Through Application Of Iron And Zinc.

Six treatments with different combinations (soil and foliar application) of Iron and Zinc along with control were tested. Maximum grain yield of 4161 kg ha^{-1} was recorded when soil application of 12 kg Fe was applied and followed soil of application of 10 kg Zn (3823 kg ha^{-1}). Minimum grain yield of 4151 kg ha^{-1} was recorded in T3(foliar application of both Iron and Zinc in combination). The Maximum iron contents (256 ppm) was observed in T_3 (Foliar application of 1.0 % Fe SO4) whereas maximum zinc contents (60.33 ppm) was found in T_2 (Foliar application of 0.5 % ZnSO4).

Table 40: Bio-fortification of wheat through application of Iron and Zinc.

Treatments	**Mean**	**Fe (ppm)**	**Zn (ppm)**
T1= Control	3655 b	110.67 d	41.67 d
T2= Foliar application of 0.5 % ZnSO4	4061 a	144 cd	60.33 a
T3= Foliar application of 1.0 % Fe SO4	4095a	256 a	44.00 cd
T4= Foliar application combination of Zn & Fe	4151a	185.33 b	51.00 bc
T5= Soil application of 10 kg Zn ha-1	4131a	141.67 cd	55.00 ab
T6= Soil application of 12 kg Fe ha-1	4058a	241.33 a	43.33 d
T7= Soil application combination of Zn & Fe	3683b	170.33 bc	45 cd
LSD(0.05) 255.12			

SEED PRODUCTION

Single Head Progenies

For maintaining the purity of the variety/seed, breeder's nucleus seed, single head progenies of each variety were planted every year. For this purpose single head rows of five commercial varieties, thirty four advanced lines of NUWYT and PUWYT were planted in the 2nd week of November. The number of head rows varied from 40 to 600 per variety/line, head rows of each variety were observed at different stages of plant development and rows deviating from the original variety were discarded. Uniform, vigorous and disease resistant rows of each variety were harvested and threshed separately. The seed of each head row was also observed for grain characteristics. Selected entries were planted as breeder's seed to produce the pre-basic seed of commercial wheat varieties whereas the seed of head rows of candidate lines was kept separately for further study. The detail of selected heads is given in Table 48.

Table 41Detail of single heads selected during 19-20

Sr. No.	Name of Variety	Single head selected	Sr. No.	Name of Variety	Single head selected
1	Faisalabad.08	200	9	Hyt-55-33	200
2	Punjab.11	100	10	V-16024	100
3	Galaxy.2013	100	11	V-16157	100
4	Ujalla.16	200	12	V-16005	200
5	Anaj.2017	200	13	V-16164	100
6	Akber	600	14	V-17157	100
7	V-12304	200	15	V-17179	100
8	V-17189	100	16	V-17175	100

Table 42 Detail of selected single heads progenies

Sr. No.	Name of Variety	Accepted progenies	Rejected progenies
1	Faisalabad.08	125	10
2	Galaxy.2013	10	0
3	Ujalla.16	130	10
4	Anaj.2017	115	15
5	Akber-19	146	15
6	HYT-55-33	17	3
7	V-16005	18	2
8	V-17157	10	0
9	V-12304	10	0

Pre-basic and basic seed production

Pure and true to type seed of a variety plays an important role in crop productivity. For maintaining the seed purity of commercial varieties and candidate lines, breeder's seed is produced from heads. From breeder's seed, pre-basic seed is produced every year, most of seed is being supplied to the Punjab Seed Corporation, Khanewal and other registered private seed companies.

Five commercial varieties of bread wheat were planted at low seed rate with self-propelled seed drill to produce the basic seed. The crop was kept under observation from tillering to maturity stages and deviating entries were discarded. As per instructions, the crop was inspected twice by the Deputy Director, FSC&RD to check the quality standards of pre-basic seed and crop purity. Besides producing the pre basic seed, a large quantity of basic seed of commercial varieties was also produced. The detail of pre-basic and basic seed production during 2015-16 is given in Table 80.

Table 43: Pre Basic And Basic Seed Produced During 2019-20

Sr. No.	Varieties	Pre Basic seed (Kg)	Basic / Certified seed(Kg)
1.	Faisalabad.08	2045	4100
2.	Galaxy-13	362	0
3.	Akbar-19	7050	4500
4.	Ujalla.16	1800	5555
5.	Anaj.2017	2500	4040
6	Zincol-16	0	3100
7	Sultan-17	400	0
8	Jau-17	280	0

SEED PRODUCTION OF BARLEY VARIETIES AND ADVANCED LINES.

Following quantity of seed of different barley varieties and advanced lines was produced for further studies.

Table 44- Quantity of barley seed produced during 2019-20.

Sr. No.	Varieties/lines	Quantity seed kg
1	Sultan.17	300
2	Jou.17	300
3	Haider 93	45
4	Jau-87	55
5	Jau-83	45

WHEAT ENTOMOLOGY

Effect of Different Climatic Factors on Wheat Aphid Population

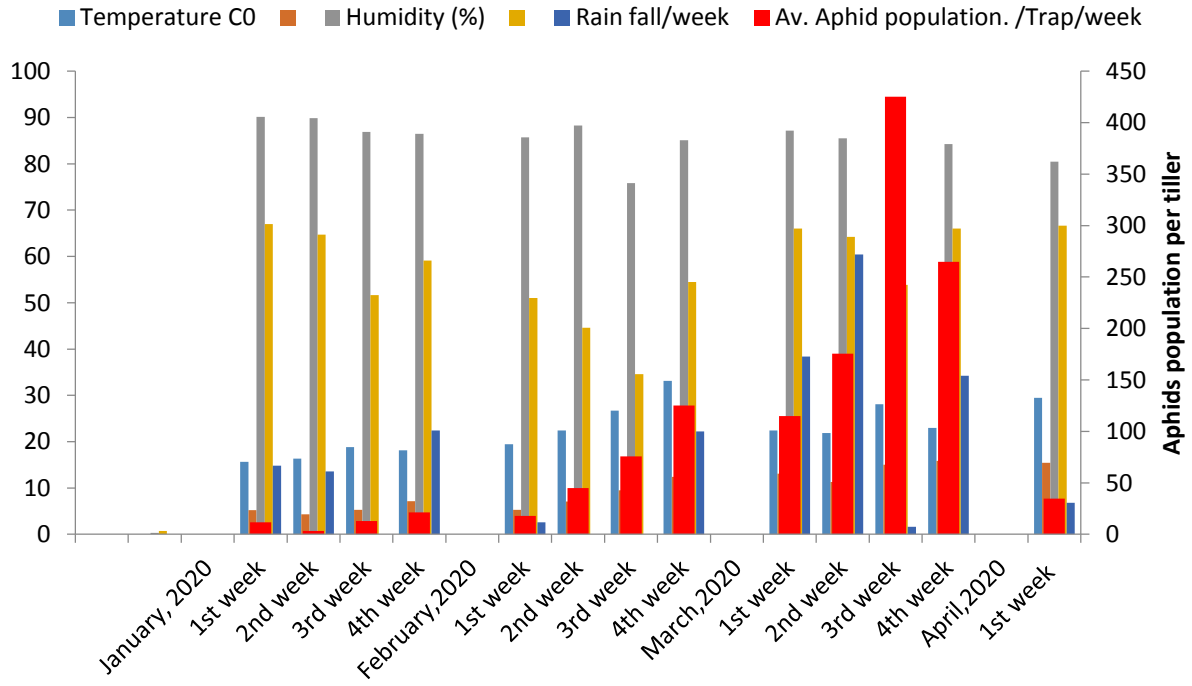
The experimental trial was conducted at the research area of wheat Research Institute, Faisalabad during 2019-20. Four Moericke Yellow water tray traps were installed at 60m apart from each other in four different fields of wheat crop at the height of 75cm from the ground level. Daily alate aphid population was recorded from these yellow tray traps and later on data was transformed into weekly basis. The weekly counts of trapped alate aphids were correlated with a-biotic factors. The results are given in the tabulated form Table 45.

TABLE-45 Average Wheat Aphid Population/ Trap/week

	Temperature C^0		Humidity (%)		Rain fall/week	Av. Aphid population. /Trap/week
	Max C^0	Min C^0	8 am	5 pm	(mm)	
January, 2020						
1st week	15.63	5.22	90.14	67.0	14.8	11.75
2nd week	16.35	4.31	89.87	64.7	13.6	3.28
3rd Month week	18.81	5.31	86.87	51.62	0.0	12.75
4th week	18.12	7.18	86.5	59.12	22.4	21.25
February,2020						
1st week	19.44	5.3	85.71	51.0	2.6	18
2nd week	22.41	7.1	88.28	44.57	0.0	45
3rd week	26.67	9.5	75.86	34.57	0.0	75.75
4th week	33.12	12.4	85.12	54.5	22.2	125.25
March,2020						
1st week	22.4	13.07	87.14	66.0	38.4	114.75
2nd week	21.87	11.31	85.5	64.25	60.4	175.5
3rd week	28.06	15.0	83.37	53.87	1.6	425.25
4th week	22.97	15.87	84.25	66.0	34.2	264.75
April,2020						
1st week	29.5	15.43	80.43	66.64	6.8	34.75

Table 46: Correlation of wheat aphid with climatic factors:

Aphid Population	Max C^0	Min C^0	R.H (%) 8.0 am	R.H (%) 5.0 pm	Rainfall (mm)
	0.464	0.721	-0.2637	0.0563	0.2292
P Value	0.1102	0.0054	0.384	0.8552	0.4512



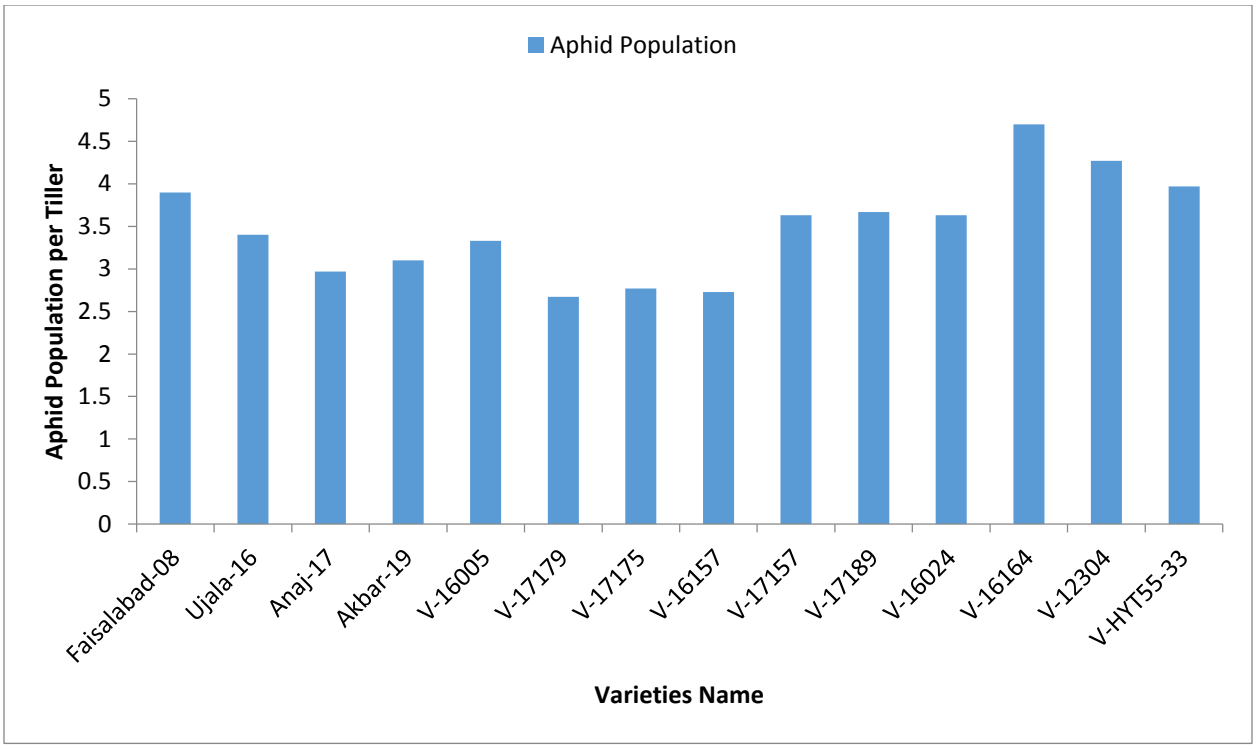
Data showed that Aphid population was started trapping on yellow water tray traps during 1st week of January-2020 (11.75/trap/week) and then gradually increased during subsequent weeks except 2nd week (3.28/trap/week) of January where rain had given detrimental effect on aphid population and peek of aphid population was observed during 3rd week of March (425.25/trap/week). Aphid population was started to decrease during 1st week of April-2020 (34.75/trap/week) due to rise of temperature. Aphid population was maximum when maximum and minimum temperature was 28.06C^0 & 15C^0, respectively with relative humidity 83.37% & 53.87% at 8am & 5pm, respectively. Aphid population showed +ve correlation with temperature but significant with minimum and non significant with maximum. While aphid population showed +ve & -ve correlation with relative humidity at 8pm & 5pm,respectively but it was non significant and rainfall had +ve correlation and non significant.

VARIETAL SCREENING OF WHEAT VARIETIES/ ADVANCE LINES AGAINST APHID

The trial was conducted at the research area of Wheat Research Institute, Faisalabad during 2019-20. Fourteen wheat varieties i.e., Faisalabad-08, Ujala-16, Anaj-17, Akbar-19, V-16005, V-17179, V-17175, V-16157, V-17157, V-17189, V-16024, V-16164, V-12304 and HYT-55-33 were screened out against aphid attack. The data of aphid population was recorded at 10 days interval during the month of February-March, 2020 from 10 randomly selected tillers of each variety/line. The aphids were dislodged on white paper sheet with the help of camel hair brush and then counted. The results are as under of the three different dates.

Table 47:Average aphid population per tiller on different wheat varieties / lines

Sr.	Varieties	26-2-2020	06-03-2020	18-03-2020	Average
1.	Faisalabad-08	3.1	3.0	3.9	3.90 ABC
2.	Ujala-16	2.9	3.6	3.4	3.40 BCDEF
3.	Anaj-17	2.6	2.8	2.9	2.97 DEF
4.	Akbar-19	2.7	3.2	3.1	3.10 CDEF
5.	V-16005	2.6	2.9	3.33	3.33 CDEF
6.	V-17179	2.1	2.9	2.7	2.67 F
7.	V-17175	2.8	2.7	2.8	2.77 EF
8.	V-16157	3.3	3.17	2.7	2.73 F
9.	V-17157	3.2	3.17	3.6	3.63 BCDE
10.	V-17189	3.8	3.7	3.7	3.67 BCD
11.	V-16024	2.8	4.1	3.6	3.63 BCDE
12.	V-16164	4.9	2.8	4.7	4.70 A
13	V-12304	4.5	4.9	4.3	4.27 AB
14	V-HYT55-33	3.3	5.3	3.9	3.97 ABC
	Lsd value at 0.05%	0.4732			



The lowest aphid population was recorded on wheat varieties/lines viz, V-17179 (2.67), V-16157 (2.73) and V-17175(2.77), respectively and these were statistically similar with each other followed by Anaj-17(2.97), Akbar-19(3.1), V-16005(3.33), Ujala-16(3.40), V-16024(3.63), V-17157(3.63), V-17189(3.67), Faisalabad-08(3.90), V-HYT 55-33(3.97), V-12304(4.27) and V-16164(4.70) aphids/tiller, respectively and these were statistically at par with each other. **Maximum aphid population was observed** on V-16164**(4.7) and it was statistically different from all other** varieties/lines

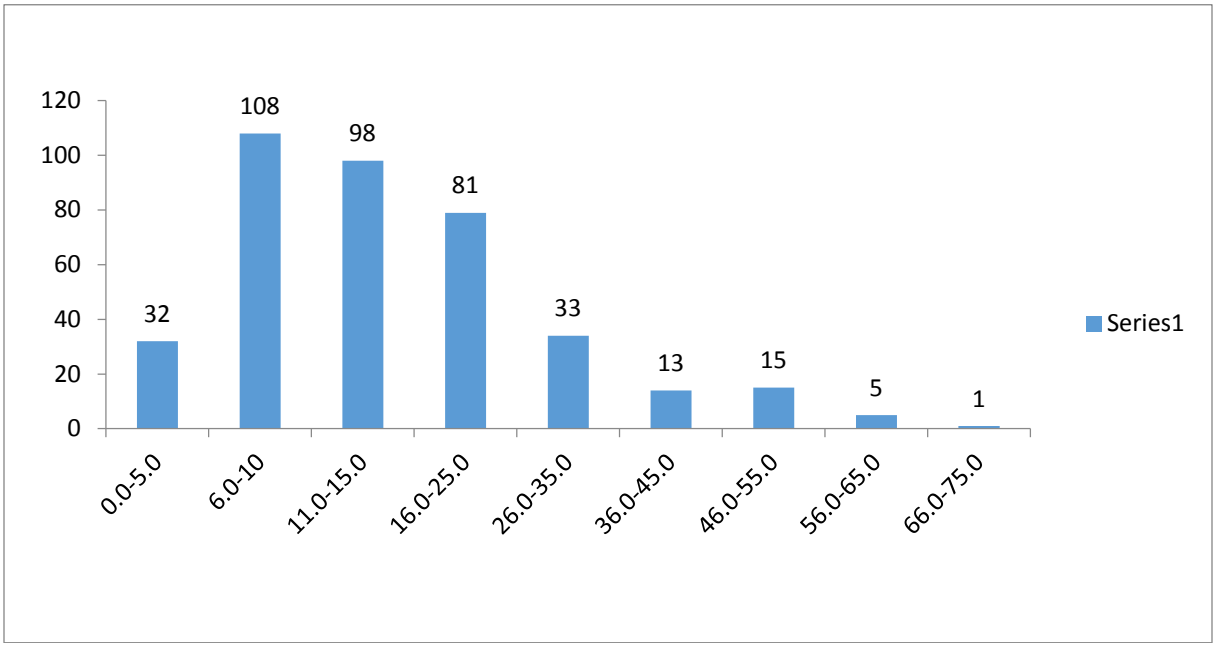
SCREENING OF WHEAT GERMPLASM AGAINST APHIDS

Trial was conducted in the research area of Wheat Research Institute, Faisalabad. Three hundred and eighty-six wheat varieties/lines of crossing block 2019-20 were screened out against aphid attack. The data of aphid population was recorded at 10 days interval during the month of February, March, 2020 from 10 randomly selected tillers of each variety/line. The aphids were dislodged on white paper sheet with the help of camel hair brush and then counted.

The results are presented in the following table 48.

Table 48: Aphid infestation on wheat germplasm S

wheat Germplasm	Total Entries	Average Aphid population/ Tiller on each variety/line (Mean values)								
	386	0-5	6-10	11-15	16-25	26-35	36-45	46-55	56-65	66-75
		32	108	98	81	33	13	15	5	1



Screening of wheat germplasm against aphids

The result showed that the aphid population ranged from 1.7 to 67 aphid/tiller. Only 32 varieties/lines had up to 5 aphids per tiller and they showed tolerance/resistance against aphid attack. These lines/varieties from crossing Block 2019-20 were CB-12,15,29,35,57,70,74,82,85,93,96,97,98,105,116,122,129,145,188,194,198,199,209,233,256,257,272,277, 297,333,347 and 383 had the lowest aphid population per tiller than others. The above mentioned varieties / lines were proposed for breeding program of variety evolving process. While the following varieties / lines in Crossing Block 2019-20 were CB-2,10,22,24,30,34,40,63,65,66,76,80,92,102,106,126,134,135,137,139,140,141,143,151,152,158,160,161,165,170,172,174,175,176,181,183,184,186,204,207,210,215,228,229,230,245,251,253,269,284,292,293,306,320,322,326,337,354,358,363,365,370,371,372,373,374 and 380 had more than 26 aphids per tiller, respectively and they were not recommended for using in crossing program.

Survey of Aphid Population on wheat Crop in Different Ecological Zones of the Punjab

The survey was conducted to record aphid infestation on different commercial wheat varieties (Faisalabad-08, Galaxy-13, Johar-16, Gandam-1, Ujala-16, Punjab-11 and Akbar-19) in 8 different districts of the Punjab i.e. Hafizabad, Gujranwala, Sialkot, Narowa l, Sheikhupura, Lahore, Nankana and Qasur. Aphid infestation was recorded in eight different districts on 18-02-2020, 19-02-2020, 24-02-2020, 25-02-2020, 02-03-2020, 03-03-2020, 09-03-2020, 10-03-2020, 16-03-2020 and 17-03-2020S. Aphid population was recorded per tiller basis by selecting 10 tillers randomly from each variety/line. The aphids were dislodged on white paper sheet with the help of camel hair brush and then counted. The results are as under in tabulated farm.

Table 49 Average aphid population on different wheat varieties in different ecological zones of the Punjab

District	**Date**	**Fsd-08**	**G-13**	**Johar-16**	**Gandm-1**	**Ujala-16**	**Pb-11**	**Akbar-19**
Hafizabad	18-2-2020 24-2-2020 2-3-2020 9-3-2020 16-3-2020	6.25	5.425	6.7	7.43	6.9	6.7	3.3
Gujranwala	18-2-2020 24-2-2020 2-3-2020 9-3-2020 16-3-2020	4.8	6.05	7.033	6.3	6.5	6.8	5.3
Sialkot	18-2-2020 24-2-2020 2-3-2020 9-3-2020 16-3-2020	6.7	6.375	7.33	7.7	7.03	6.9	4.7
Narowal	18-2-2020 24-2-2020 2-3-2020	7.825	7.675	7.966	9.6	8.9	8.9	7.2

	9-3-2020 16-3-2020							
Sheikhupura	19-2-2020 25-2-2020 3-3-2020 10-3-2020 17-3-2020	9.025	9.075	8.26	8.57	7.8	6.4	7.9
Lahore	19-2-2020 25-2-2020 3-3-2020 10-3-2020 17-3-2020	7.8	8.825	7.9	9.02	8.7	8.2	5.5
Kasur	19-2-2020 25-2-2020 3-3-2020 10-3-2020 17-3-2020	8.4	9.725	8.65	9.4	9.8	8.7	6.2
Nankana	19-2-2020 25-2-2020 3-3-2020 10-3-2020 17-3-2020	9.17	9.5	8.275	8.533	9.23	7.9	5.7

Survey revealed that aphid population on different wheat varieties ranged from 4.8-9.17, 5.42-9.72, 6.7-8.65, 6.3-9.6, 6.5-9.8, 6.4-8.7 and 3.37.9 aphid/tiller on Faisalabad-08, Galaxy-13, Johar-16, Gandum-1, Ujala-16, Punjab-11 and Akbar-19,respectively. Aphid population was recorded more on Galaxy-13 and Gandum-1 in Kasur and Narowal districts and low in Hafizabad and Sialkot on Akbar-19 and in Gujranwala district on Faisalabad-08, respectively.

WHEAT PATHOLOGY

WHEAT PATHOLOGY

Disease Trap Nurseries

To monitor the virulence pattern of rust resistant genes as well as for the observation of blast symptoms on foliar part of plant especially head/spike. Trap nurseries were planted at eight different locations i.e Faisalabad, Bahawalpur, Khanewal, Kala Shah Kaku, Kot Naina, Islamabad, Pirsabak and Peshawar. Leaf and yellow rust data was recorded for all these locations. Yellow rust was prevalent at all the locations. The genes Yr-5, Yr-10 and Yr-15 were free from the disease. All the wheat varieties were affected by yellow rust. Galaxy-13, Punjab-11, Inq-91, Watan, AARI-11 etc were badly affected. Rust genes Lr-10, Lr-11, Lr-21, Lr-22 A, Lr-28 and Lr-34 were free from leaf rust while stem rust was not observed.

Screening OF Wheat Advanced Lines against Rust

Nine entries of NUWYT, Forty five entries of PUWYT and two hundred and twenty entries of station yield trials were evaluated against rust. The entries HYT 55-33, V-17179, V-16024, V-18610, V-18620, HYT 70-16, HYT 70-20, v-18038, V-18319, V-18352, V-18409, V-18503, V-18485, V-18594, HYT 100-3, HYT 100-15, HYT 100-23, HYT 100-27, HYT 100-29 etc showed good tolerance against leaf and yellow rust.

Investigation on Newly Emerging Foliar Diseases of Wheat under Changing Climatic Conditions

Rust survey was conducted in almost all districts of Punjab. Scientists of Wheat Research Institute Faisalabad, Regional Research Institute Bahawalpur, Arid Zone Research Institute Bhakhar and Barani Agri. Research Institute Chakwal Participated in this activity which was conducted through co-ordination of CIMMYT. Two thousands and five (**2005)** locations were visited in all Divisions of Punjab during Februray-March 2020. General crop condition was normal. Crop was recovering from lodging occurred due to rains coupled with wind and hail storms.

The central Punjab has shown low occurrence of rust. Districts of upper Punjab like, Narowal, Gujranwala, Mandi Bahudin, Sargodha and Sialkot had low to moderated intensity of rust. Yellow rust was found in almost all Districts of Southern Punjab with moderate to high intensity. Similarly, Mianwali, Layyah and Bhakkar in Thal areas all showed yellow rust. Yellow rust was also observed in Barani Districts Attock, Rawalpindi, Jhelum and Gujrat. The rust monitoring teams of research wing found rust in 1072 locations in the Punjab. Rust has been observed on approximately 5 to 6 % of the wheat area. The farmers has applied recommended fungicides (Tebuconazole, Propiconazole or trifloxystobin + Tebuconazole) on rust fields which had positive impact to check the spread of wheat. The rust attack is sever on old / susceptible wheat varieties like TD-1, Sehar-06, Watan, Gandam-01, Inqlab-91, AS-2002 and Bakkar-2002, AARI-11, Galaxy-13 etc. The varieties Anaj-17, Ujala-16, Ghazi-19, Akbar19, Bhakhar Star, Fakhre Bhakhar, Pakistan 13, etc. has shown better tolerance against yellow rust. Leaf rust occurrence was negligible in farmers Field. Stem rust and blast were not observed at any location however

Table 50: The summery of rust position is tabulated below:

Sr. No.	Name of District	Locations visited	Presence of yellow rust noted	Remarks
1.	Faisalabad	67	6	Low/Moderate intensity of yellow rust,
2.	T.T. Singh	82	6	
3.	Chiniot	21	3	
4.	Jhang	88	17	
5.	Sargodha	75	19	
6.	Hafizabad	56	11	
7.	Khanewal	43	3	
8.	Pakpattan	35	7	
9.	Okara	30	3	
10.	Sahiwal	42	8	
11.	Shiekhupura	59	15	
12.	Nankana	23	9	
13.	Lahore	38	12	
14.	Kasoor	38	14	
15.	Mandi Bahauddin	58	18	Yellow Rust occurred in most of the field but fields with old and susceptible varieties had moderate to heavy attack.
16.	Narowal	51	32	
17.	Gujranwala	34	18	
18.	Sialkot	42	24	
19.	Khushab	52	37	
20.	Mianwali	84	78	
21.	Layyah	103	79	
22.	Bhakkar	131	89	
23.	Jhelum	74	65	
24.	Gujrat	99	68	

25.	Chakwal	61	30	
26.	RawalPindi	87	69	Yellow rust found with moderate to high intensity in fields of old varieties. In fields with new resistant varieties & sprayed fields of old varieties rust was under control.
27.	Attock	58	37	
28.	Lodhran	26	17	
29.	Rahim Yar Khan	45	36	
30.	Rajanpur	43	36	
31.	D.G. Khan	50	43	
32.	Multan	27	22	
33.	Muzaffar Garh	36	33	
34.	Bahawalpur	82	61	
35.	Bahwal Nagar	41	36	
36.	Vehari	24	11	
Total		**2005**	**1072**	

Barley(Hordeum vulgare L.)

Maintenance and Improvement of Barley Germplasm

During the year, one hundred genotypes were maintained. Two lines were rejected on the basis of poor performance and disease susceptibility. True to type heads from remaining entries were selected and threshed to maintain the genetic purity. Some important traits recorded are as under,

Table 51 : Genetic diversity of different traits in germplasm during 2019-20

Sr. No.	Character	*Range*
1	Plant height	59-118 cm
2	Days to heading	88-115 days
3	Spike length	4.3-11.1 cm
4	No. of grains per spike	14-84

FILIAL GENERATIONS

F_1, F_6 & F_7 Generations

Twenty entries from F1, Five entries from F6 and Seventeen entries from F7 were harvested. The entries selected from F6 and F7 generations were promoted to Preliminary Yield Trial.

PRELIMINARY BARLEY YIELD TRIALS (A-TRIALS)

Twenty eight advanced lines of barley were sown in this experiment (A1 and A2) with check varieties Sultan-17/Jau-17 and Jau-87, out of which eight lines produced higher grain yield than check varieties in A1 experiment. In A2 experiment seven lines produced more grain yield than check variety Jau-17.

Table 52 - Yield performance of promising lines in A-trials

A1			A2		
Ranking	**Entry Name**	**Yield (kg ha^{-1})**	**Ranking**	**Entry Name**	**Yield (kg ha^{-1})**
1	B-19013	4696	1	B-19026	4971
2	B-19014	4654	2	B-19022	4721
3	B-19001	4635	3	B-19024	4163
4	B-19009	4456	4	B-19027	4146
5	B-19011	4278	5	B-19016	4054
6	B-19003	4264	6	B-19021	3978
7	B-19002	4218	7	B-19017	3942
8	B-19012	4163	8	Jau-17	3930
9	Jau-87	4142	9	Jau-87	3905
10	B-19005	4037	10	B-19019	3901
11	Sultan-17	3923	11	B-19028	3872
12	B-19007	3858	12	B-19015	3686
13	B-19008	3782	13	B-19018	3682
14	B-19010	3589	14	B-19025	3483
15	B-19004	3456	15	B-19023	3457
16	B-19006	3344	16	B-19020	3078
	LSD (0.05%)	468		LSD (0.05%)	480

REGULAR BARLEY YIELD TRIAL (B-TRIAL)

In this experiment fourteen advanced lines of barley were sown with check varieties Sultan-17 and Jau-87 and maximum yield was shown by entry B-18021 (4894 kg/ha) followed by entry B-18004 (4737 kg/ha) while the check variety Sultan-17 produced grain yield of 4161 kg/ha as follows.

Table 53- Yield performance of promising lines in B-trial

Ranking	**Entry Name**	**Yield (kg ha^{-1})**
1	B-18021	4894
2	B-18004	4737
3	B-18016	4498

4	B-18009	4475
5	B-18010	4193
6	B-18027	4191
7	B-18003	4166
8	Sultan-17	4161
9	Jau-87	4118
10	B-18008	3826
11	B-18024	3811
12	B-18012	3786
13	B-18002	3687
14	B-18022	3569
15	B-18023	3523
16	B-18026	3477
	LSD(0.05%)	483.25

PUNJAB UNIFORM BARLEY YIELD TRIAL

Ten advanced lines of barley were sown in this experiment with check varieties Sultan-17 and Jau-87 at different seven districts of Punjab.

On overall mean basis three advanced lines of barley produced higher grain yield than check variety Sultan-17. Advanced line B-17011 produced maximum grain yield of 3881 kg/ha followed by B-17009 (3813 kg/ ha) and B-17010 (3810 kg/ha) while the check variety Sultan-17 produced grain yield of 3671 kg/ha.

Table -54: Yield performance of promising lines in PUBYT trial (kg/ha)

Name	WRI FSD	Bahawalnagar	Dhakkar	Kala Shah Kaku	Gujranwala	Depalpur	Mandi bahaudin	Average Yield
B-17011	3661	4804	3867	3046	3679	4571	3540	3881
B-17009	4433	4649	3694	2404	3635	4351	3526	3813
B-17010	4186	4588	3914	2992	3138	3989	3861	3810
Sultan-17	3514	4570	3781	2667	3188	4176	3800	3671
B-17016	3519	4041	4018	2919	3697	4351	3149	3670
B-17034	3958	4579	3712	2682	3196	3938	2959	3575
Jau-87	3567	4585	3346	2474	3186	3958	3876	3570
B-16035	3956	3879	3711	3294	3159	3249	2942	3456
B-17013	4319	4472	3093	2178	3343	3196	3420	3431
LHR-AGB-1	4097	4249	3349	2813	3074	3340	2858	3397
B-15012	3356	3790	3449	1925	2511	3794	3164	3141
B-16020	3067	3515	3899	1992	2412	3494	3249	3090

DETERMINATION OF SUITABLE PLANTING TIME IN BARLEY CROP

Nine advanced barley lines along with check varieties Sultan-17, Jau-17 and Jau87 were planted in this experiment with 15 days interval.

Table 55 - Yield performance of barley advanced lines sown at different times (kg/ha)

Name	5th Nov	20th Nov	5th Dec	Average
B-15035	4252	4544	4130	4309
B-17039	4224	4631	3991	4282
B-16035	4396	4442	3814	4217
B-14035	3955	4170	4484	4203
B-14003	4613	3941	3963	4172
Sultan-17	4191	4224	4070	4162
B-15018	4709	4101	3631	4147
Jau-17	4189	4247	3832	4089
B-15006	3760	4451	3781	3997
Jau-87	4060	4247	3663	3990
B-17016	3442	4232	3319	3664
B-15012	3326	3878	3706	3637
Cd1 for sowing dates =293.83, for Varieties =343.13 and for Interaction = 635.71				

The advanced line B-17039 gave maximum grain yield of 4631 kg/ha at second planting (20 th November). On overall mean basis, advanced line B-15035 produced maximum grain yield (4309 kg/ha) followed by B-17039 (4282 kg/ha) and B-16035 (4217 kg/ha) while check variety Sultan-17 produced grain yield of 4162 kg/ha. Five advanced lines performed better than check variety Sultan-17. It was also revealed from the result that mid of November is suitable time for barley planting.

BARLEY RAINFED YIELD TRIAL

Fourteen advanced lines of barley were sown in this experiment with check varieties Jau-17 and Jau-87 in normal irrigated and rainfed conditions.

Table 56 - Yield performance of barley advanced lines under normal and rainfed conditions (kg/ha)

Name	Normal Irrigation	Rainfed condition	Average
B-16011	4088	3821	3954
B-15035	4364	3269	3817
B-19029	3543	4077	3810
B-17039	4249	3360	3805
B-14035	4043	3437	3740
B-15006	3952	3394	3673
Jau-87	4077	3258	3668
B-15018	3984	3347	3666
Jau-17	3903	3258	3581
B-16035	3470	3197	3333
B-14003	3616	3031	3323

B-19030	3140	2525	2833
Cd1 for irrigation level =516.93, for Varieties =410.53 and for Interaction = 716.04			

On overall mean basis the advanced line B-16011 produced maximum grain yield of 3954 kg/ ha followed by B-15035 (3817 kg /ha) while, the check variety Jau-87 produced grain yield of 3668 kg/ha. Under rainfed conditions maximum yield was shown by B-19029 (4077 kg/ha).

SEED PRODUCTION OF BARLEY VARIETIES AND ADVANCED LINES.

Head rows and Head row progenies of five commercial varieties of barley were studied. 15 to 50 head rows of each were selected for raising progeny blocks. The seed harvested from progeny blocks of Jau-17 and Sultan-17 was got approved as prebasic seed.

The quantity of seed produced of each variety is given below

Table 57 - Quantity of barley seed produced during 2019-20.

Sr. No.	Varieties	Kg	Sr. No.	Varieties	Kg
1.	Sultan-17	300	4.	Jau-87	55
2.	Jau-17	300	5.	Jau-83	45
3.	Haider-93	45			

DURUM WHEAT (*Triticum durum* Desf.) 2019-20

Maintenance of Germplasm and Hybridization

The main objective of research work on durum is to develop high yielding, good quality and disease resistant wheat varieties through interspecific crosses. Two hundred and forty-six (246) cultivars/ advanced lines of durum and triticale were sown to make the desirable cross combinations. Forty (40) crosses were attempted and 38 fresh crosses were harvested for next year's planting.

Filial Generations (F_1-F_7)

F_1-Generation

Fifty-three crosses were planted in a single row of 2.5m length along with their parents to compare their morphology and vigor. Forty-nine crosses having desirable traits were harvested to advance the generation.

F_2-F_7 Generations

The filial generations (F_2-F_7) were sown and selected for desirable traits. Segregating materials were surrounded by the spreader rows of highly susceptible variety (Morocco). Modified bulk method was used for selection in F_2, F_3 and F_4 generations. From F_5, uniform, disease resistant and desirable heads were selected to raise single head rows of F_6 generation. Outstanding and stable lines from F_6 were

selected and harvested for inclusion in F_7 generation. Entries studied and selected in different generations are given in the Table 1. -

Table 58: Details of Filial Generations of Durum wheat

Sr. No.	Generation	Entries Studied	Entries Selected
2	DF1	53	49
3	DF2	56	50
4	DF3	31	31
5	DF4	21	21
6	DF5	11	200 S.H (10 Crosses)
7	DF6	285 SHR	97 SHRP
8	DF7	70	56

Yield trials

Station Yield Trials

The most promising lines selected from different sources i.e. F_7 generation, international nurseries/ trials, drought, heat stress and plant pathology program were evaluated in station yield trials (A & B Trials).

Preliminary durum yield trial (A-Trial)

During the reported year, four trials of durum wheat were conducted under normal conditions. Each normal trial consisted of 15 test entries/lines with 3 check varieties (Durum-97, Wadanak-85 & Ujala-16). The planting was done following RCB design with three replications. The lines that performed better than the three checks are given in Table-2 with their data regarding days to heading, days to maturity, plant height, lodging %age, disease reaction and grain yield.

Table 59: Yield performance and related traits of promising Durum lines in preliminary yield trials

Sr. no	Line/ Genotype	Days to 50% heading	Days to maturity	Disease reaction		Plant height (cm)	Yield Kg/ha
				Leaf rust	Yellow rust		

1	D-18817	120.00	155.00	0	0	90.67	4777
2	D-18827	113.00	135.00	TMS/MR	0	90.00	4950
3	D-18834	118	161.00	0	0	95.00	4535
5	D-18847	111.00	155.00	0	0	93	4131
6	D-18849	108.00	153.33	0	0	95.33	4139
7	D-18830	115	155.00	0	0	75.67	4322
8	D-18851	115	161.33	0	MS/MR	95	4193

Regular durum yield trial (B-Trial)

Regular durum wheat yield trial was conducted under normal conditions. Trial was planted with plot size of 6 m x 0.27 m using RCB design with three replications and harvested plot size was 5 m x 0.27 m. Trial consisted of 17 test entries/lines with 2 check varieties (Durum-97 & Ujala-16). Promising lines that surpassed three check varieties are given in Table 3 with their respective data of days to heading, days to maturity, plant height, lodging %age, disease reaction and grain yield.

Table 60: Yield performance and related traits of promising Durum lines in regular yield trials

Sr. no.	Line/ Variety	Days to 50% heading	Days to maturity	Disease reaction		Plant height (cm)	Yield Kg/ha
				Leaf rust	Yellow rust		
1	D-18704	112	158.00	TMR	0	90.00	3821
2	D-18707	109.00	155.00	TMR	MS/MR	80.00	4914
3	D-18713	119	158.00	MS	MS	85.00	4169
4	D-18718	114	158.00	0	0	80	4357
5	D-18721	113.00	155.00	TMR	MS/MR	90.00	4163

WHEAT RESEARCH SUB-STATION, MURREE

RUST TRAP NURSERY

Rust trap nursery consisting of 250 entries (YR trap nursery 80 entries, LR trap nursery 85 entries and SR trap nursery 85 entries) were sown in field during June 2019. The first disease symptoms appeared on 04-09-2019. Only leaf rust spores were trapped and among 85 entries, 21 showed the visible disease symptoms. The data on Lr is given in the Table 1.

Table 61: Disease data on rust Trap Nursery 2019-20

S. No	Variety/ Line	Origin	Reaction
1	Otb-6 (DW Check)		20 MS
2	TC*6/Lores (RL 6047)	Lr2c	5 MS

3	TC*6 Democrat (RL 6002)	Lr3	5 MS
4	TC*6 Aniversario (RL 6007)	Lr3Ka	15 MS
5	Bage/8*TC (RL6042)	Lr3Bg	20 MRMS
6	TC*6Exchange/ (RL 6004)	Lr10	25 MRMS
7	Kussar (W976)	Lr11	5 MS
8	Exchange /6*TC (RL 6011)	Lr12	25 MS
9	Lee 310/6*TC (RL 6012)	Lr23	10 MS
10	TC*6/Agent (RL 6064)	Lr24	15 MS
11	Transec (Awned)	Lr25	30 MRMS
12	TC*6/ST-1-25 (RL 6078)	Lr26	50 MRMS
13	CS2D-2M	Lr28	25 MS
14	TC*6/CS7AG#11 (RL 6080)	Lr29	20 MS
15	TC*6/P158548 (RL 6057)	Lr33	25 MRMS
16	TC*6/P158548 (RL 6058)	Lr34	20 MS
17	RL 5711	Lr35	50 MRMS
18	E84018	Lr36	40 MRMS
19	TC*6/VPM (RL6081)	Lr37	30 MS
20	TC*6// CARINA (RL 6051)	Lr B	30 MS
21	WL 711	Lr13	15 MS

RUST INOCULUM INCREASE

Inoculum collected from field during summer 2019 was increased on morocco in green house. Morocco seed were grown in small pots and seven days old seedlings were inoculated with rust spores using water as a medium. Two weeks after inoculation the inoculum was collected and stored in the capsule for next year inoculation.

SEED INCREASE OF RUST DIFFERENTIAL SETS

Rust differential lines are important in disease studies by their use in race identification analysis. Thus, the purity of seed of these differential lines is equally important to avoid any mistakes about the identification of pathogen races. A set of 39 near isogenic lines of leaf rust differentials were sown in small pots under greenhouse conditions during June 2019. To maintain their purity and to avoid mechanical mixtures, after heading the spikes were covered with the glycine bags. Upon maturity the seed was harvested and stored in small bags.

OFF- SEASON GENERATION ADVANCEMENT

Advancement of filial generations during summer season is of the most important aspect to be accomplished. In this way two generation in a year can be taken which will directly aid to varietal development prosses and also for the development of RILs. A set of 30 lines of F1 sown in the field during June 2019. Data on plant height, days to heading, days to maturity, spike length and disease resistance recorded (Table 2). Upon maturity the seed was harvested and sent to main station for winter sowing.

MULTIPLE GENERATION TRAIL

An experiment was conducted to harvest more than one generations in a year under greenhouse conditions. A trail consisting of 40 entries were sown 30-04-2019 in small pots as first generation. The seed was harvested on 08-07-2019 and sown immediately after harvest for second generation. The second generation was harvested in October 2019. The total duration of first generation was 68 days and for second generation was 90 days. Seed of second generation was sent to main station for winter sowing.

DEVELOPMENT OF BACK CROSSES

Eleven lines from F1 were selected during July 2019 and emasculation done on ten spikes from each line. Crosses were made using pollen from parents sown separately. Seed of ten crosses harvested and sent to main station.

Table. 62: Field Data on F1 lines

S. No.	Entry	Days to heading	Days to maturity	Plant height (cm)	Spike Length (cm)	Visibe disease symptoms (LR)
1	PBN-46	59	106	58	08	0
2	PBN-46/PBN-67	62	106	56	08	0
3	PBN-46/PBN-73	53	110	52	09	0
4	PBN-46/PBN-80	56	106	55	09	10MR
5	PBN-47	59	110	56	08	0
6	PBN-46/PB-67	63	110	60	08	0
7	PBN-47/PBN-73	63	114	59	07	0
8	PBN-47/PBN-80	63	114	59	07	0
9	PBN-47/PBN-81	62	114	60	09	0
10	PBN-47/PBN-83	62	106	60	08	0
11	PBN-47/PBN-86	52	106	58	08	0
12	PBN-47/PBN-96	52	106	62	08	0
13	PBN-49	59	110	60	09	25MR
14	PBN-49/PBN-67	49	100	65	08	0

15	PBN-49/PBN-73	52	108	60	08	0
16	PBN-49/PBN-80	59	108	65	09	0
17	PBN-49/PBN-81	59	108	65	08	0
18	PBN-49/PBN-83	61	110	65	09	20MR
19	PBN-49/PBN-86	52	110	60	09	0
20	PBN-49/PBN-46	52	110	62	09	0
21	PBN-50	54	106	60	09	0
22	PBN-50/PBN-101	54	106	62	09	0
23	PBN-50/PBN-109	64	110	62	07	40MS
24	PBN-50/PBN-135	65	110	62	09	0
25	PBN-50/PBN-143	61	110	65	08	0
26	PBN-50/PBN-144	61	110	58	09	0
27	PBN-50/PBN-145	57	110	60	09	0
28	PBN-50/PBN-147	50	100	59	08	60MRMS
29	PBN-52	59	106	62	09	0
30	PBN-52/PBN-67	59	106	61	08	0

Kala Shah Kaku Trials 2019-20

Following material were planted at Kala Shah Kaku during 2019-20

i. Segregating generations
ii. Local Disease screening nursery (LDSN)
iii. PUWYT and NUWYT

Filial Generations

In segregating generations, 53 entries of F_2, 89 entries of F_4, 29 entries of F_5 and 20 entries of F_6 and 50 entries of F_7 were studied. Out of them 45, 71, 29, 20 and 38 entries were selected respectively on the basis of plant aspects and disease reaction.

Kala Shah Kaku Trials 2018-19

Following material were planted at Kala Shah Kaku during 2018-19

i. Track record of wheat varieties
ii. Segregating generations
iii. Local Disease screening nursery (LDSN)
iv. PUWYT and NUWYT

Filial Generations

In segregating generations,53 entries of F_1 , 123 entries of F_3 ,74 entries of F_4, 30 entries of F_5 and 26 entries of F_6 were studied. Out of them 53, 89, 29, 20,25 were selected respectively on the basis of plant aspects and disease reaction

Cereal Technology

Title: Effect of germinated barley flour addition in whole wheat flour on the quality of chapatti

Flour of Anaj-17 was used as control. Jau-17 was germinated and its flour was added in the whole wheat flour of Anaj-17 to gauge the impact of value addition on chapatti quality.

Table 63: impact of value addition on chapatti quality

Treatments	Whole Wheat Flour (%)	Germinated Barley Flour (%)
T0	100	0
T1	95	5
T2	90	10
T3	85	15
T4	80	20
T5	75	25

As the germinated barley flour proportion increased, it reduces CH_2O and gluten content while moisture, protein, and mineral matter increased significantly. Moreover, fat content increased in non significant fashion. Flour blends rheology revealed that water absorption capacity and dough development time increased while stability reduced as the barley flour proportion increased. Germinated barley flour addition at 25% level exhibited fairly good chapatti quality but 20% barley flour blend showed good chapatti quality.

Title: Effect of local storage conditions of the previous crop years on quality and germination behavior of current wheat varieties/lines

22 wheat lines from National Wheat Breeding Programme of the crop year 2017-18, 2018-19 and 2019-20 were collected and stored under local storage conditions. In this way effect of local storage on quality characteristics and germination behavior of these lines was tested after suitable time interval.

It was observed that as the moisture increased in the same samples during three years storage, their protein contents were dropped significantly. Moreover, dry gluten and wet gluten of the samples followed similar pattern. However, when the moisture of the same coded samples kept for three years under local storage conditions dropped, their protein content, dry gluten and wet gluten were raised significantly. Almost all the 22 samples kept under local storage conditions of

three years showed similar trend. Moreover, minimum germination % age of 39 was recorded in coded sample No. 14 of first year (2017-18) having 38.39% germination energy (GE) and maximum value of 99% germination was observed in third year (2019-20) coded sample No. 3 possessing 52.43% GE.

Table 64: Effect of storage conditions on quality and germination behavior of current wheat varieties/lines

Sample Code	Crop Year	Moisture (%)	Protein (%)	Zeleny	Wet gluten (%)	Dry gluten (%)	Gluten Index	Falling Number (Sec)	Germination (%)	Germination Index
1	2017-18	9.9	15.0	59	29.36	9.24	58.0	400	67	35.07
	2018-19	9.8	15.1	78	29.43	9.40	63.0	349	84	41.12
	2019-20	9.6	15.2	84	29.70	9.58	70.0	310	94	48.36
3	2017-18	10.0	15.3	70	35.32	11.08	46.0	409	90	45.31
	2018-19	9.8	15.4	81	35.68	11.13	49.0	343	91	46.82
	2019-20	9.2	16.3	83	35.70	11.50	70.8	300	99	52.43
4	2017-18	9.7	15.4	67	30.67	9.58	52.0	393	78	40.69
	2018-19	9.6	16.0	79	31.06	9.83	63.0	356	91	47.31
	2019-20	9.6	16.0	81	33.60	10.44	71.0	289	92	48.28
6	2017-18	9.8	16.1	65	31.23	9.81	58.0	379	83	43.76
	2018-19	9.8	16.1	78	34.33	10.81	68.0	300	88	44.10
	2019-20	9.7	16.5	83	36.72	11.45	86.0	295	88	45.21
8	2017-18	10.0	16.4	63	28.84	8.98	46.0	387	77	38.58
	2018-19	9.6	16.4	66	33.17	10.86	60.0	300	88	44.33
	2019-20	9.5	16.7	84	40.56	12.63	86.0	289	91	44.79
10	2017-18	9.8	15.4	76	24.63	7.03	67.0	348	77	39.81
	2018-19	9.6	15.6	80	31.85	9.76	75.0	315	86	42.49
	2019-20	9.2	16.2	86	31.95	10.41	88.0	295	87	46.71

11	2017-18	10.4	16.1	80	30.97	9.50	41.0	402	68	34.18
	2018-19	10.2	16.4	80	34.44	10.42	47.0	368	79	38.38
	2019-20	9.9	16.8	86	38.71	11.50	68.0	317	93	45.89
12	2017-18	10.3	15.6	75	28.81	9.69	43.0	423	93	49.09
	2018-19	10.1	16.0	77	33.36	10.25	46.0	365	94	49.14
	2019-20	9.6	16.4	79	33.93	10.53	62.0	360	94	49.96
13	2017-18	9.9	14.8	76	31.25	10.29	25.0	438	89	44.78
	2018-19	9.7	15.3	78	31.80	10.33	36.0	394	89	45.59
	2019-20	9.5	16.4	80	34.53	10.60	72.0	362	93	47.88
14	2017-18	10.1	15.4	76	27.49	8.69	20.0	441	78	38.39
	2018-19	10.0	15.6	78	30.17	9.06	38.0	399	81	40.84
	2019-20	9.8	16.0	79	33.88	11.02	44.0	359	87	57.04
15	2017-18	10.0	15.0	72	32.07	9.85	58.0	458	74	38.50
	2018-19	9.2	15.2	73	33.02	10.10	43.0	419	87	44.42
	2019-20	9.2	15.6	77	33.54	10.77	73.0	387	89	47.21
16	2017-18	9.7	16.2	77	34.79	11.07	42.0	457	81	41.93
	2018-19	9.6	16.2	82	36.61	11.10	61.0	396	91	48.00
	2019-20	9.5	16.4	89	38.25	12.05	63.0	351	95	48.12
17	2017-18	9.8	15.5	55	34.77	11.36	38.0	403	80	41.21
	2018-19	9.8	16.0	81	37.17	11.62	39.0	370	93	44.30
	2019-20	9.3	16.4	82	37.82	12.39	41.0	354	94	49.43
18	2017-18	10.0	16.3	56	35.12	11.04	38.0	402	75	38.88
	2018-19	10.0	16.3	78	36.67	11.31	42.0	342	93	48.82
	2019-20	9.4	16.6	85	37.00	11.56	77.0	309	96	50.54

20	2017-18	10.0	15.2	62	33.26	10.24	49.0	433	77	36.43
	2018-19	9.7	16.3	65	34.93	11.11	60.0	399	83	43.55
	2019-20	9.2	16.5	89	35.12	11.36	68.0	388	93	49.76
23	2017-18	9.7	16.4	56	33.54	10.30	21.0	440	65	29.70
	2018-19	9.2	16.4	68	39.46	12.78	43.0	384	88	46.84
	2019-20	9.0	16.5	85	43.19	14.50	53.0	354	91	48.39
25	2017-18	9.8	16.1	47	34.78	10.60	37.0	433	62	32.55
	2018-19	9.0	16.4	78	35.96	11.76	50.0	370	74	38.03
	2019-20	8.5	16.8	83	48.09	12.84	54.0	350	97	50.60
26	2017-18	9.5	16.4	68	27.18	8.68	57.0	426	72	35.64
	2018-19	9.5	16.4	82	29.31	9.87	69.0	380	88	41.38
	2019-20	9.4	16.4	85	32.10	10.29	72.0	357	93	48.47
27	2017-18	10.1	15.6	55	28.21	8.45	47.0	449	94	48.58
	2018-19	9.2	15.7	78	29.22	9.26	55.0	391	96	49.00
	2019-20	9.2	15.8	84	33.86	10.60	71.0	355	97	51.61
28	2017-18	10.1	15.2	62	29.31	9.84	59.0	451	85	45.49
	2018-19	9.8	15.8	70	31.38	9.88	63.0	401	89	47.52
	2019-20	9.6	15.9	85	32.23	10.26	65.0	367	91	48.21
30	2017-18	10.1	15.3	57	32.34	9.94	57.0	456	89	45.96
	2018-19	9.4	15.9	68	32.55	10.24	65.0	412	93	46.08
	2019-20	9.4	15.9	81	32.87	10.30	74.0	311	97	48.50
31	2017-18	10.0	15.0	63	28.04	8.68	49.0	446	81	41.86
	2018-19	9.4	15.4	79	34.22	9.89	54.0	405	83	41.97
	2019-20	9.4	16.0	81	37.11	11.59	90.0	382	88	43.03

Title : Effect of germinated barley flour addition in wheat flour on the quality of biscuits, cakes and bread

Flour of Anaj-17 was used as control. Jau-17 was germinated and its flour was added in the flour of Anaj-17 to gauge the impact of value addition on biscuits, cakes and bread quality as; T_0 = 100% Flour of Anaj-17;T_1 = 5% germinated barley Flour + 95% Anaj-17 flour; T_2 =10% germinated barley Flour + 90% Anaj-17 flour;T_3 =15% germinated barley Flour + 85% Anaj-17 flour and T_4 = 20% germinated barley Flour + 80% Anaj-17 flour.

As the germinated barley flour proportion increased, it reduces CH_2O and falling number value while gluten content, calorific value and mineral matter increased significantly. Moreover, fat and protein content increased in non significant fashion. Flour blends rheology revealed that water absorption capacity and dough development time increased while stability reduced as the barley flour proportion increased. Germinated barley flour addition at 20% level for bread production revealed poor loaf volume, poor crumb and pore structure. 15% barley flour blend biscuits showed product acceptability. Color of the biscuits changed from creamy white to dull brown and the texture became hard at 20% barley flour in wheat flour. Moreover, 15% barley flour blend cakes showed product acceptability while cake sensory acceptability deteriorated at 20% germinated barley flour addition.

Table 65: Chemical Composition of Various Flour blends.

Treatments	Moisture (%)	Protein (%)	Gluten (%)	Fat (%)	CH_2O (%)	Ash (%)	Energy (KCal)	Falling number (Sec)
T0	12.97	11.7	22	1.49	73.9	0.45	355.00	541
T1	12.20	11.6	20	1.54	72.40	1.51	355.90	325
T2	12.33	11.8	23	1.60	72.00	1.76	356.08	310
T3	12.51	11.9	24	1.72	71.70	1.89	358.00	280
T4	13.12	12.0	24	1.78	70.0	2.45	359.80	250

Table 66: Sensory Evaluation Bread

Treat	Texture cell size	Crumb color	Pore structure	Odor	Loaf volume	Overall Acceptability
T0	8.9	8.5	8.6	8.5	8.7	8.8
T1	6.6	6.6	6.4	6.4	7.0	6.7

T2	6.1	6.0	6.3	6.5	6.7	6.2
T3	5.9	5.9	6.0	6.1	5.7	5.8
T4	4.9	4.8	5.8	5.9	4.9	5.1

Table 67: Biscuit

Treat	Crumb color	Crust color	Texture	Taste	Order	O.A
T0	8.2	8.9	8.3	8.5	8.2	8.6
T1	8.1	8.5	8.2	8.1	8.1	8.2
T2	7.8	7.7	7.9	8.0	7.9	7.6
T3	6.6	6.5	6.5	6.9	6.7	6.4
T4	5.2	5.3	5.1	5.5	5.6	5.3

Table 68: Cake

Treat	Color	Texture	Crumb color	Aroma	Taste	Overall acceptability
T0	8.0	8.5	9.0	8.5	8.2	9.0
T1	8.0	8.0	9.0	8.1	8.1	9.0
T2	8.0	7.7	7.9	7.5	7.9	8.0
T3	7.0	6.5	6.5	6.9	6.7	7.0
T4	6.0	5.3	5.1	5.5	5.6	5.4

TITLE: QUALITATIVE ANALYSIS OF WHEAT BREEDING MATERIAL FOR IRON AND ZINC

Flour of wheat breeding material was made through UDY Cyclone sample mill. Flour was used for the qualitative estimation of iron and zinc concentration through Dithizone staining and Prussian Blue Procedure.

Table 69: Dithizone staining for Zinc estimation in Wheat

High Zinc (50-65ppm)	Medium Zinc (38-49ppm)	Low Zinc (< 37ppm)
36 lines / varieties i.e. 20, 22, 25, 26, 43, 52, 53, 54, 55, 58, 61, 62, 64, 65, 66, 70, 71, 80, 99, 100, CB-161, CB-162, CB-163, CB-165, CB-167, CB-172, CB-233, CB-241, CB-243, CB-343, CB-359, CB-371, CB-377, CB-381, CB-456 and CB-494.	**83 lines / varieties i.e.** 1-2, 4, 6-8, 10-19, 21, 23-24, 27-42, 44-51, 56-57, 59-60, 63, 67-69, 73-74, 77-78, 85, 88, 90-91, 102-103, CB-152, CB-156, CB-166, CB-236, CB-239, CB-250-51, CB-263, CB-337, CB-349, CB-364, CB-370, CB-372, CB-374, CB-378-79, CB-489, CB-496, CB-501, CB-585, CB-586 and CB-589.	**44 lines / varieties i.e.** 3, 5, 9, 72, 75-76, 79, 81-84, 86-87, 89, 95-98, 101, CB-235, CB-237, CB-336, CB-361, CB-369, CB-375-76, CB-382, CB-457-58, CB-460-461, CB-464-65, CB-467, CB-474, CB-481, CB-497, CB-515, CB-517, CB-527, CB-530, CB-539, CB-542, and CB-544

Table 70: Prussian Blue Procedure for Iron estimation in Wheat

High Fe (51.7-74.7ppm)	Medium Fe (40.3-40.8 ppm)	Low Fe (30.8-35.7 ppm)
87 lines / varieties i.e. 1-71, 74, 78, 83, 87-92, 98, CB-101, CB-163, CB-237, CB-241, CB-379, CB-487.	**57 lines / varieties i.e.** 73, 75, 77, 79, 81-82, 84, 86, 94-97, CB-102-103, CB-156, CB-161, CB-166-167, CB-172, CB-233, CB-235-36, CB-239, CB-263, CB-343, CB-348, CB-359, CB-361, CB-369, CB-370-72, CB-374-77, CB-381-82, CB-457, CB-460-61, CB-464, CB-474, CB-481, CB-489, CB-496, CB-501, CB-513, CB-517, CB-527, CB-539, CB-542, CB-544, CB-585-587 and CB-589.	**27 lines / varieties i.e.** 72, 80, 93, 96, 99-100, CB-162, CB-165, CB-243, CB-246, CB-250-51, CB-336-37, CB-343, CB-349, CB-359, CB-361, CB-365, CB-377-78, CB-456, CB-458, CB-465, CB-494, CB-527 and CB-544.

Title: Quality evaluation of bread wheat advanced lines/varieties

Five hundred and sixty entries in National Uniform Wheat Yield Trials and Punjab Uniform Wheat Yield Trials collectively were analyzed for their qualitative and quantitative potential.

NUWYT (Coded) 2019-20

Table 71: No. of Samples = 180

PLOT	1000G/WT	TEST/WT	PROTEIN	MOISTURE	STARCH	GLUTEN	ZELENY

NO							
1	34.0	70.6	15.7	9.7	51.9	29	65
2	37.0	73.4	14.9	9..5	53.4	27	57
3	39.5	72.6	14.9	9.7	53.4	25	54
4	37.6	74.1	13.5	10.3	53.0	25	67
5	30.8	71.8	13.9	9.4	55.2	26	52
6	37.1	72.3	15.8	9.5	51.3	33	70
7	40.0	70.9	14.9	10.3	51.9	28	67
8	39.0	75.0	15.4	9.6	53.2	29	61
9	37.0	76.1	16.2	9.2	52.3	34	74
10	35.1	74.3	15.4	9.8	52.6	30	71
11	36.6	76.5	15.0	9.7	53.4	29	71
12	33.5	70.1	15.2	9.7	52.9	28	61
13	35.0	75.7	14.8	10.3	52.9	27	60
14	37.2	72.6	14.6	10.6	52.4	24	59
15	36.2	73.1	14.8	10.2	52.0	28	69
16	39.9	78.5	14.8	9.3	53.2	28	69
17	39.6	78.9	15.9	9.5	52.8	33	61
18	35.2	74.2	16.1	9.0	53.8	33	58
19	40.1	76.6	13.2	10.1	54.6	21	64
20	33.5	75.7	15.3	9.4	53.5	29	71
21	39.8	76.2	14.0	9.7	53.4	25	66
22	34.0	70.0	13.5	10.4	53.3	24	49
23	33.6	74.1	13.8	9.4	54.1	23	61
24	38.9	76.0	12.5	9.8	55.7	21	56
25	40.5	73.4	14.0	10.2	54.2	25	63
26	38.0	75.6	14.3	10.8	52.0	23	69
27	35.3	74.2	12.6	10.7	52.3	19	49
28	38.7	76.5	15.1	9.8	52.1	29	69
29	39.4	78.5	14.1	9.2	56.0	26	49
30	40.9	75.7	15.3	10.0	53.0	29	71
31	38.0	77.6	15.2	9.6	53.0	28	66
32	35.6	76.3	14.1	10.0	53.7	23	62
33	36.3	73.6	12.3	9.4	56.4	21	54
34	31.3	70.0	15.4	9.3	50.5	29	70
35	42.5	74.1	14.0	10.3	51.2	24	54
36	41.7	75.7	15.8	10.0	51.5	29	69
37	41.0	74.2	15.7	9.2	53.4	32	63
38	25.7	69.7	14.6	9.9	51.0	30	68
39	37.1	75.1	13.6	10.3	54.1	23	49
40	36.5	72.7	15.2	9.9	53.5	29	62
41	37.2	75.5	14.4	10.3	53.6	27	70
42	35.2	75.1	12.6	10.1	55.6	21	39

43	45.3	73.4	14.7	9.9	52.3	29	62
44	38.7	70.0	14.8	10.0	52.5	26	61
45	40.8	72.8	15.5	10.0	53.6	29	57
46	31.1	76.0	12.8	10.4	52.9	23	58
47	39.6	72.3	14.1	9.9	51.5	24	45
48	38.9	75.7	14.9	9.9	53.0	26	66
49	37.4	74.8	15.1	10.3	52.2	29	70
50	38.3	75.6	14.1	9.8	53.0	27	67
51	34.2	74.8	14.0	9.6	53.4	26	57
52	37.6	72.7	13.9	9.5	53.7	25	59
53	37.7	74.3	14.6	9.6	52.8	27	68
54	41.6	77.9	14.9	9.6	53.2	27	69
55	40.5	76.7	12.6	10.1	55.4	20	55
56	41.4	74.9	13.3	9.5	55.5	23	59
57	32.2	76.4	11.6	9.7	55.4	19	50
58	41.5	75.7	13.2	10.4	53.0	22	67
59	37.5	72.7	15.7	9.8	52.4	31	71
60	32.7	74.4	15.3	9.7	51.9	27	68
61	34.3	72.8	15.9	9.9	51.3	29	74
62	42.7	72.8	14.5	9.8	53.7	27	70
63	37.6	72.2	13.0	9.2	54.9	24	63
64	34.4	73.1	13.4	9.8	54.9	25	66
65	30.7	72.9	13.1	10.1	54.7	23	65
66	33.4	72.3	14.0	9.9	52.8	22	57
67	34.5	70.1	15.5	10.3	51.9	29	77
68	43.6	73.3	12.5	9.3	54.9	21	30
69	39.9	73.6	15.8	10.3	51.9	30	75
70	33.5	73.7	14.6	9.8	53.5	26	74
71	38.8	74.8	14.3	9.6	53.9	25	64
72	37.0	73.1	14.9	10.3	52.7	25	68
73	34.7	69.9	15.2	10.4	51.5	27	75
74	30.2	74.6	16.1	9.6	52.2	30	69
75	41.5	75.7	15.4	10.0	51.3	29	67
76	35.2	72.3	15.8	9.7	52.5	29	72
77	42.6	73.6	15.5	9.8	52.3	30	66
78	33.6	71.9	14.7	10.3	52.0	27	72
79	37.6	71.6	14.3	10.0	53.2	26	67
80	36.3	71.7	13.9	9.6	53.4	24	59
81	38.4	76.2	15.1	9.2	54.5	29	70
82	31.3	69.7	14.2	10.6	49.5	24	66
83	40.5	75.0	14.7	10.5	52.1	27	74
84	38.6	73.6	14.9	10.0	53.1	26	71
85	32.9	72.2	13.9	10.1	53.5	24	50

86	39.7	74.0	14.9	10.3	52.8	28	72
87	31.9	70.4	13.8	10.0	53.1	22	44
88	40.3	72.9	14.2	10.5	52.1	25	66
89	42.0	74.1	12.8	9.8	53.6	23	36
90	39.8	73.0	13.1	10.3	54.2	23	50
91	40.2	75.4	14.0	9.8	53.7	25	65
92	38.4	74.3	12.4	9.8	56.0	21	54
93	35.2	72.4	13.4	10.2	53.8	24	58
94	34.7	72.1	13.0	10.2	54.5	23	51
95	31.9	71.7	12.1	9.8	55.3	19	42
96	34.3	74.2	15.5	9.6	52.1	30	71
97	41.3	75.6	14.0	10.3	54.0	24	65
98	36.2	72.7	13.9	9.7	53.9	24	48
99	37.5	70.1	14.5	9.3	54.6	29	60
100	35.2	71.2	14.6	9.2	54.1	29	56
101	40.7	75.7	14.2	10.1	53.3	24	59
102	37.8	72.3	13.9	10.3	51.0	23	61
103	37.4	71.3	13.4	10.1	53.0	23	55
104	41.8	77.7	12.9	10.0	55.3	21	43
105	36.3	72.3	12.7	10.0	54.4	22	54
106	4.5	77.1	13.8	9.2	54.5	27	52
107	41.4	78.9	14.3	9.8	54.8	24	69
108	38.0	74.7	14.3	9.6	53.1	25	66
109	43.7	76.8	12.8	9.7	55.0	22	47
110	40.2	75.3	51.2	10.2	54.7	23	62
111	40.5	76.8	14.2	9.5	54.3	27	64
112	36.2	75.9	13.6	10.3	54.7	23	60
113	35.3	75.1	13.4	10.2	53.6	23	62
114	37.8	75.1	15.2	9.4	53.4	27	64
115	32.8	74.8	13.1	9.8	55.6	23	42
116	35.0	70.8	14.0	9.9	53.8	24	46
117	37.1	75.2	14.7	9.2	53.9	28	59
118	38.6	75.3	14.5	9.4	53.8	27	56
119	41.2	76.8	13.9	10.4	51.2	24	66
120	35.2	72.3	14.2	9.3	55.3	27	57
121	42.4	76.3	14.3	9.4	55.1	26	61
122	36.1	72.4	14.6	10.2	52.5	26	69
123	37.4	71.6	13.9	9.1	54.3	26	50
124	32.6	71.2	13.0	9.9	55.0	22	42
125	31.7	73.4	14.5	9.5	54.5	28	63
126	38.3	74.9	15.8	10.2	52.5	30	57
127	40.8	76.8	15.7	10.1	52.0	28	71
128	40.0	79.1	13.5	10.1	53.4	19	65

129	43.9	70.8	12.0	10.4	54.6	18	60
130	40.3	76.2	13.9	9.5	54.2	24	52
131	39.0	74.5	13.6	9.7	54.1	23	60
132	39.0	74.5	13.6	9.7	54.1	23	60
133	37.7	73.2	13.9	10.0	53.1	26	61
134	38.5	76.8	13.5	10.7	53.2	21	70
135	36.5	72.8	13.2	10.0	54.2	21	44
136	39.4	72.1	12.8	10.1	54.1	22	52
137	39.3	76.6	12.3	9.3	55.3	21	53
138	35.6	74.4	13.1	10.0	55.0	23	63
139	36.6	73.4	14.2	9.8	53.1	26	71
140	37.8	71.7	13.9	9.9	54.4	27	62
141	39.1	73.1	13.5	10.2	54.5	23	54
142	33.4	74.0	13.5	9.9	54.8	25	46
143	35.7	75.9	12.2	10.7	53.3	20	62
144	33.6	76.3	12.2	10.6	55.1	19	62
145	34.8	71.4	13.5	9.4	55.9	23	45
146	44.3	75.2	14.3	9.7	53.4	26	57
147	39.0	76.0	13.5	10.2	54.3	24	51
148	36.1	74.1	13.1	9.9	54.8	21	43
149	37.4	76.4	11.8	10.5	55.0	18	47
150	40.3	77.3	13.9	10.0	54.6	26	60
151	39.0	74.2	13.2	10.5	53.6	21	51
152	38.4	73.6	14.2	9.3	54.3	26	66
153	41.0	77.4	12.9	9.4	53.7	23	41
154	30.8	72.4	16.0	10.1	51.4	33	77
155	36.3	73.4	15.5	10.1	52.1	30	68
156	36.9	73.8	15.0	9.5	53.8	26	67
157	37.4	74.6	15.0	9.4	53.9	28	57
158	41.0	70.8	14.8	9.2	53.5	27	62
159	40.4	74.5	13.5	10.0	53.3	22	67
160	38.3	71.8	15.2	10.0	52.8	28	70
161	36.3	70.8	12.7	10.5	54.4	20	42
162	33.8	74.4	13.7	10.2	54.4	24	51
163	35.7	76.3	13.9	9.8	54.5	25	58
164	36.5	75.4	15.1	9.5	53.3	29	72
165	39.1	73.9	15.6	9.8	52.9	30	67
166	39.6	74.1	14.7	10.0	53.3	25	64
167	45.8	74.4	15.0	9.3	53.6	27	68
168	38.0	73.9	14.3	9.8	53.3	25	60
169	38.4	75.0	16.0	9.1	54.1	32	71
170	33.6	72.5	15.2	9.8	52.1	30	72
171	41.2	77.2	13.5	10.7	53.2	21	55

172	35.5	74.6	12.3	9.3	55.8	20	54
173	34.0	74.9	13.5	9.6	55.0	24	58
174	39.5	75.4	13.0	10.6	53.6	20	64
175	39.6	73.3	12.3	10.5	54.4	20	54
176	32.8	72.2	13.7	9.9	53.7	23	66
177	37.9	76.8	12.8	10.4	55.0	20	45
178	38.1	74.3	12.5	10.6	51.6	19	66
179	39.8	75.9	14.7	10.2	53.8	23	55
180	36.0	74.1	15.0	9.9	52.3	30	72

NUWYT SET 2 (2019-20)

Table 72: No. of Samples = 24

PLOT NO	1000G/WT	TEST/WT	PROTEIN	MOISTURE	STARCH	GLUTEN	ZELENY
1	32.2	68.3	13.0	10.6	53.8	21	48
2	43.0	74.0	15.7	10.0	52.8	30	65
3	38.9	76.6	15.5	10.0	52.9	29	76
4	36.4	73.4	15.0	9.6	53.2	28	71
5	37.1	72.2	14.9	9.7	53.5	26	53
6	34.6	69.2	14.4	9.8	53.2	25	52
7	38.7	74.0	13.1	10.3	54.9	21	47
8	36.3	71.1	14.5	10.2	53.0	27	58
9	36.4	73.4	15.5	9.7	53.3	30	62
10	40.8	72.9	15.1	98	52.4	28	68
11	34.2	64.6	14.9	9.7	53.6	26	55
12	43.5	78.6	15.0	10.2	53.1	27	69
13	37.5	70.0	15.4	10.3	51.1	23	63
14	48.4	73.8	14.4	10.1	51.4	28	57
15	34.0	71.6	15.2	9.9	52.5	27	64
16	34.9	70.0	15.4	10.3	51.1	23	63
17	35.4	71.9	14.3	10.6	52.2	21	49
18	36.9	72.4	15.2	9.8	53.5	29	61
19	34.4	70.3	14.6	10.3	52.8	27	68
20	37.0	72.6	13.9	10.6	52.6	24	60
21	38.5	71.4	14.6	10.3	52.9	27	69
22	33.1	70.0	15.1	10.0	52.0	29	68
23	38.5	73.2	14.2	10.2	53.2	25	60
24	39.1	73.7	15.8	10.0	50.9	30	71

NUWYT (Non Coded) 2019-20

Table 73: No. of Samples = 60

PLOT NO	1000G/WT	TEST WT	PROTEIN	MOISTURE	STARCH	GLUTEN	ZELENY
1	40.1	78.8	13.8	10.4	53.8	23	51
2	43.0	76.8	13.1	9.9	55.1	23	47
3	35.8	72.1	13.4	10.2	54.0	23	56
4	35.5	70.0	14.0	10.4	51.8	23	59
5	37.2	75.6	13.0	10.5	53.9	21	44
6	36.3	75.2	13.9	10.2	53.5	24	51
7	37.3	74.2	14.4	10.3	53.3	26	60
8	33.7	74.9	12.7	10.4	55.3	20	47
9	41.6	74.1	13.3	10.6	53.0	23	56
10	35.0	74.6	13.4	10.5	54.2	22	51
11	40.5	80.8	13.4	10.3	54.5	23	53
12	41.8	72.6	12.9	10.5	54.8	19	49
13	36.7	74.3	13.2	10.0	55.1	23	50
14	27.6	69.8	12.3	10.5	54.2	21	44
15	40.5	75.6	14.0	10.4	53.7	26	57
16	41.7	76.2	14.2	10.2	53.8	25	62
17	39.7	74.3	12.0	10.5	54.3	23	49
18	39.2	74.4	13.9	10.3	53.4	23	55
19	37.9	75.1	13.5	10.1	55.0	24	55
20	40.6	75.6	13.6	10.3	53.3	23	52
21	36.8	73.4	14.5	9.9	53.4	27	60
22	40.3	78.0	14.5	9.3	53.6	26	63
23	33.7	74.0	13.7	10.5	53.5	23	55
24	38.5	75.7	12.9	10.6	53.9	21	51
25	35.5	75.6	13.0	10.2	55.0	23	51
26	36.4	75.3	11.6	10.2	56.1	18	34
27	43.9	76.3	11.8	10.1	55.6	18	38
28	34.3	72.5	12.3	10.9	52.1	18	43
29	37.6	74.5	13.7	10.5	53.9	25	56
30	41.8	74.6	12.4	10.4	52.3	18	41
31	37.2	72.7	14.1	10.1	53.6	25	65
32	38.8	71.1	12.3	10.3	55.1	20	46
33	38.7	76.1	13.3	10.9	53.1	20	53
34	37.2	71.1	14.8	10.1	52.7	28	63
35	26.1	69.4	13.9	10.0	53.0	25	53
36	33.2	73.7	13.4	10.6	53.1	23	51
37	38.9	74.6	16.2	9.5	52.4	31	66
38	43.2	77.7	11.8	10.4	55.2	17	56
39	45.6	75.7	12.4	10.3	55.2	20	44

40	38.7	76.3	13.8	10.5	53.1	23	56
41	40.0	78.6	12.4	10.2	55.0	19	43
42	38.7	77.2	11.2	10.1	56.7	16	36
43	40.1	75.7	13.9	10.3	53.2	24	37
44	35.6	71.1	12.9	10.6	53.3	23	47
45	35.1	74.1	14.6	10.3	52.6	25	58
46	36.2	73.9	13.7	10.5	53.1	23	64

Plot No	1000 Grain WT	Test Wt	Protein	Moisture	Starch	Gluten	zelney
47	37.9	74.6	14.9	9.8	53.1	28	67
48	31.0	72.1	16.2	9.8	51.2	33	74
49	37.9	75.0	14.4	10.3	53.5	25	66
50	38.7	74.9	13.2	9.7	54.8	24	57
51	38.8	79.1	14.2	10.2	53.4	26	59
52	38.4	73.4	12.8	10.5	54.6	19	49
53	41.0	77.1	12.6	10.7	51.8	20	44
54	45.8	73.3	13.2	10.6	52.9	24	56
55	34.4	71.1	13.3	10.1	53.8	21	45
56	36.0	75.1	12.7	10.5	55.3	20	47
57	40.0	78.4	12.5	11.0	54.2	20	51
58	39.9	76.0	12.9	10.3	54.7	21	51
59	36.6	72.6	13.2	10.3	54.7	21	52
60	32.9	73.0	14.0	10.3	52.7	26	63

NUWYT (2019-20)

Table 74: No. of Samples = 120

1.	43.5	75.1	14.3	10.5	52.3	23	60
2.	38.8	75.6	15.3	10.1	53.4	29	63
3.	40.1	79.5	15.2	10.1	53.4	27	70
4.	48.1	75.6	13.7	10.3	52.9	26	70
5.	44.4	72.9	13.8	10.4	54.7	26	53
6.	38.1	75.7	16.0	10.2	52.1	30	63
7.	40.0	74.1	15.0	10.1	52.5	29	69
8.	34.5	74.1	16.1	10.2	51.2	32	76
9.	36.8	77.0	15.2	10.3	52.9	30	66
10.	33.9	76.3	15.2	10.2	52.5	29	70
11.	32.8	71.1	14.3	10.5	53.5	27	71
12.	32.5	71.7	14.9	10.1	53.3	26	66
13.	38.2	75.6	14.7	10.2	53.0	26	69
14.	34.6	77.6	15.0	10.3	52.5	27	63
15.	33.8	75.2	14.5	9.8	52.2	28	75
16.	37.7	73.4	14.3	10.3	53.1	27	64
17.	38.5	78.7	13.4	10.3	55.0	24	44
18.	30.4	66.4	13.9	10.5	52.6	24	62
19.	39.2	76.6	15.6	10.2	52.6	30	71
20.	37.2	77.8	14.3	10.3	53.7	27	64
21.	33.2	71.3	13.0	10.4	54.7	22	55
22.	38.5	74.8	13.9	10.4	53.9	26	65
23.	32.2	73.9	14.6	10.3	52.9	27	69
24.	33.3	73.8	13.8	10.5	54.1	25	51
25.	41.4	79.2	15.8	10.0	52.6	30	73
26.	39.0	78.9	15.8	10.3	50.8	31	71
27.	38.9	72.6	13.2	10.1	52.5	22	60
28.	39.6	77.8	15.1	10.1	52.1	29	66
29.	39.0	70.7	15.4	10.3	51.8	31	78
30.	42.8	75.8	15.6	10.1	52.9	30	75
31.	37.6	77.8	14.7	10.4	53.1	28	64
32.	38.1	75.4	14.3	9.8	54.7	26	65
33.	33.2	75.5	14.6	10.5	52.7	27	68
34.	38.2	73.9	15.7	10.1	51.1	28	67
35.	37.8	77.2	15.8	10.5	52.9	29	75
36.	45.2	75.6	15.4	9.7	53.6	29	64
37.	28.6	73.3	15.3	10.4	53.2	29	61
38.	34.9	77.6	14.2	10.3	53.3	25	66
39.	35.7	78.3	13.1	10.4	54.1	22	64
40.	34.1	76.6	14.0	10.6	55.3	28	57
41.	30.5	73.1	13.1	10.1	55.1	24	45
42.	41.8	73.0	14.1	10.5	52.6	28	66

43.	37.7	73.2	15.5	10.0	53.7	32	71
44.	35.3	74.6	14.2	10.6	53.8	27	57
45.	30.7	74.1	15.3	10.2	53.3	28	70
46.	42.0	80.0	13.5	10.7	51.2	22	54
47.	37.0	75.5	14.9	10.0	53.1	27	67
48.	40.8	74.3	14.8	10.4	52.5	28	65
49.	39.7	79.9	14.2	10.2	53.4	27	65
50.	33.4	74.3	14.6	10.2	53.4	27	57
51.	37.5	76.6	14.4	10.2	53.0	27	67
52.	42.0	75.3	15.8	10.0	51.9	30	69
53.	40.1	75.0	15.6	10.4	53.6	29	62
54.	35.5	77.1	14.6	10.3	53.3	26	56
55.	40.9	79.7	15.5	10.1	52.5	30	69
56.	40.4	75.2	13.5	10.1	53.8	24	58
57.	38.6	76.3	13.9	10.3	53.6	26	59
58.	37.8	76.1	14.7	10.7	53.0	27	61
59.	33.8	72.3	13.8	10.6	52.4	27	67
60.	37.6	73.4	14.5	10.1	53.8	26	55
61.	39.0	77.1	13.5	9.9	53.5	24	68
62.	40.0	74.1	13.8	10.2	53.4	26	62
63.	35.4	72.9	13.9	10.2	54.0	26	67
64.	32.5	70.9	13.7	10.3	54.4	25	55
65.	32.1	71.5	16.0	10.2	52.5	28	73
66.	36.1	77.7	14.7	10.2	53.7	28	58
67.	39.8	78.4	13.5	10.5	50.3	19	67
68.	37.4	75.8	16.0	10.4	52.3	30	64
69.	33.9	74.1	15.2	10.3	53.1	27	62
70.	41.7	73.7	15.7	10.5	52.3	32	68
71.	39.5	77.6	15.5	9.9	53.3	28	65
72.	33.0	69.8	15.4	10.0	52.4	30	74
73.	29.0	74.6	15.7	9.9	53.2	30	64
74.	40.1	72.5	14.6	10.2	52.2	30	71
75.	31.6	75.2	15.4	10.1	53.4	29	62
76.	34.4	73.8	14.7	10.4	53.8	27	64
77.	38.2	74.6	10.0	10.0	53.4	27	60
78.	38.3	79.0	10.1	10.1	53.4	25	67
79.	39.7	73.3	10.0	10.0	52.4	27	65
80.	39.7	73.3	10.0	10.0	52.4	27	65
81.	39.4	80.0	14.4	10.5	53.7	28	57
82.	34.1	75.2	13.4	10.5	51.5	22	62
83.	41.0	72.3	14.1	10.4	53.0	26	67
84.	38.7	79.3	14.5	10.5	53.2	25	57
85.	33.7	76.9	13.9	10.3	53.8	25	56

86.	39.0	74.2	14.5	10.2	53.6	27	63
87.	38.9	76.2	15.9	9.9	51.8	31	73
88.	40.0	75.9	13.7	10.5	53.6	25	52
89.	42.2	76.9	13.3	10.8	52.0	24	47
90.	30.9	73.4	14.1	10.6	52.8	26	61
91.	41.2	78.8	15.5	9.8	53.1	29	70
92.	35.8	75.7	13.4	10.4	54.7	25	47
93.	35.2	72.6	14.2	10.4	52.7	24	67
94.	41.9	76.6	14.3	10.5	53.4	27	57
95.	30.6	71.8	14.6	10.4	52.8	27	67
96.	35.0	76.8	15.7	10.4	51.8	32	68
97.	35.6	76.1	14.8	10.3	53.8	25	63
98.	32.3	70.1	14.4	10.1	53.6	25	56
99.	34.1	77.4	13.7	10.7	54.3	24	49
100.	34.3	72.3	13.5	10.9	53.0	25	53
101.	43.7	74.6	13.6	10.2	54.3	24	49
102.	39.1	77.8	14.1	10.0	53.8	26	67
103.	37.3	72.8	15.1	10.4	52.2	26	66
104.	35.5	74.8	15.0	10.1	53.7	27	63
105.	31.1	67.2	14.1	10.1	52.3	23	70
106.	39.3	72.6	15.1	10.4	52.5	29	67
107.	38.7	78.7	15.4	10.2	53.9	28	68
108.	39.6	79.6	15.3	10.2	52.3	30	73
109.	42.2	76.2	15.4	9.8	52.4	28	68
110.	41.6	77.3	14.5	10.1	53.9	26	56
111.	33.5	72.9	14.6	10.4	54.0	29	60
112.	34.4	75.7	15.8	10.0	53.5	34	67
113.	32.0	73.9	14.2	10.3	53.3	25	63
114.	36.1	74.1	15.9	10.2	51.9	30	71
115.	31.1	76.9	13.2	10.0	55.5	24	41
116.	31.3	70.6	13.6	10.2	53.6	23	57
117.	41.3	79.1	13.6	10.2	53.7	24	65
118.	38.8	78.0	14.1	10.2	54.3	27	52
119.	39.2	75.6	14.2	10.0	52.8	27	68
120.	36.1	77.4	14.7	10.3	53.3	27	68

PUWYT (Normal) 2019-20

Table 75: No. of Samples = 100

Plot	1000G/WT	TEST WT	PROTEIN	MOISTURE	STARCH	GLUTEN	Zeleny

1	39.3	76.4	13.8	9.2	55.1	25	67
95	35.7	72.2	13.9	10.6	53.5	24	73
Average	37.5	74.3	13.85	9.9	54.3	24.5	70
2	38.9	72.1	12.7	9.7	55.7	20	53
76	37.4	74.3	14.3	10.3	52.6	26	72
Average	38.15	73.2	13.5	10	54.15	23	62.5
3	38.5	72.9	13.3	10.1	54.9	22	47
100	36.1	76.2	14.8	9.5	54.1	27	68
Average	37.3	74.55	14.05	9.8	54.5	24.5	57.5
4	42.9	77.2	11.8	10.7	55.4	17	60
56	45.2	80.1	12.7	10.2	54.4	20	54
Average	44.05	78.65	12.25	10.45	54.9	18.5	57
5	40.8	73.7	13.7	10.5	53.8	22	51
71	39.9	75.3	15.3	9.4	53.5	29	62
Average	40.35	74.5	14.5	9.95	53.65	25.5	56.5
6	40.2	76.3	13.9	10.7	51.7	24	65
96	37.3	75.4	13.3	10.1	54.3	22	69
Average	38.75	75.85	13.6	10.4	53	23	67
7	39.1	75.6	16.2	10.4	51.2	33	76
91	33.6	70.2	14	10.1	52	21	60
Average	36.35	72.9	15.1	10.25	51.6	27	68
8	34.5	74.5	14.6	10.4	53.4	26	68
79	33.4	75.6	14.8	9.6	53.4	28	70
Average	33.95	75.05	14.7	10	53.4	27	69
9	39.4	72.8	14.6	9.5	53.5	28	61
83	42.5	73.2	12.4	10.4	55.1	20	46
Average	40.95	73	13.5	9.95	54.3	24	53.5
10	39	77.7	13.3	10.5	54.5	24	54
53	42.7	80	11.7	10.7	56	19	52
Average	40.85	78.85	12.5	10.6	55.25	21.5	53
11	39	76.5	12.7	10.3	55.6	20	45
97	38	75.9	13.5	10.1	54.7	24	76
Average	38.5	76.2	13.1	10.2	55.15	22	60.5
12	41.9	76.3	12.6	10.5	54.6	20	62
80	37.9	72.8	14.1	10.4	51.6	26	71
Average	39.9	74.55	13.35	10.45	53.1	23	66.5
13	36.5	76	13.1	9.6	55.8	22	63
72	36.1	74.8	14.2	10.5	53.3	25	65
Average	36.3	75.4	13.65	10.05	54.55	23.5	64

14	36.8	76.8	12.3	10.9	54.8	19	55
67	39	77.2	13.9	10.4	53.7	22	54
Average	37.9	77	13.1	10.65	54.25	20.5	54.5
15	35.3	71.8	13.2	10.5	54	20	56
90	32.2	67.4	14.4	10.4	52.2	22	62
Average	33.75	69.6	13.8	10.45	53.1	21	59
16	35.7	72.4	12.5	9.6	56.4	20	39
70	33	75.5	15	9.3	53.9	28	62
Average	34.35	73.95	13.75	9.45	55.15	24	50.5
17	38.5	73.2	13.4	10.4	54.2	24	66
61	37.1	74.3	13.8	10.4	53.4	25	72
Average	37.8	73.75	13.6	10.4	53.8	24.5	69
18	38.3	74.7	13	10	54.9	21	59
77	36.5	75	14.4	10.1	54.1	24	59
Average	37.4	74.85	13.7	10.05	54.5	22.5	59
19	39	72.8	14	10	54.1	24	66
58	39.9	72.8	15	10.5	53.1	28	63
Average	39.45	72.8	14.5	10.25	53.6	26	64.5
20	37.3	73.2	14.1	9.7	52.7	21	64
82	37.2	75.1	13.8	10.4	53.5	20	52
Average	37.25	74.15	13.95	10.05	53.1	20.5	58
21	37.7	74.8	13.7	10.4	54.5	23	62
94	36.2	73.6	14.3	10.4	54	25	57
Average	36.95	74.2	14	10.4	54.25	24	59.5
22	35.9	74.6	15.2	9.3	52.6	31	72
85	41	74.8	13	10.4	54.8	25	67
Average	38.45	74.7	14.1	9.85	53.7	28	69.5
23	37.9	76.1	14.5	9.2	55.3	26	69
86	40.5	78	12.6	10	55.2	21	54
Average	39.2	77.05	13.55	9.6	55.25	23.5	61.5
24	38.2	76.4	14.2	9.6	52.5	24	67
75	34.6	77.4	13.6	9.7	55.1	23	57
Average	36.4	76.9	13.9	9.65	53.8	23.5	62
25	39.6	70.2	16.1	9.5	51.7	31	74
65	40.8	70.7	14.2	10.3	53	24	66
Average	40.2	70.45	15.15	9.9	52.35	27.5	70
26	35	73.1	12.5	10.4	54.5	20	68
87	37	73.8	11.5	10.5	55.7	17	55
Average	36	73.45	12	10.45	55.1	18.5	61.5

27	37	78.2	13.2	10.2	54.3	22	62
64	35.7	72.8	12.4	10.5	54	18	55
Average	36.35	75.5	12.8	10.35	54.15	20	58.5
28	38.4	76.3	14.1	10.2	53.6	25	66
84	36.2	74.4	12.8	9.9	55.5	21	49
Average	37.3	75.35	13.45	10.05	54.55	23	57.5
29	37.1	77.3	16.3	9.7	51.1	36	80
57	44.4	78.2	14.9	10.1	52.5	29	69
Average	40.75	77.75	15.6	9.9	51.8	32.5	74.5
30	35.8	72.1	13.5	10.5	54	22	51
99	39.7	78.6	15.9	9.9	53	28	70
Average	37.75	75.35	14.7	10.2	53.5	25	60.5
31	36.4	76.2	14	9.9	53.9	23	61
59	35.2	74.7	14.2	10.2	53	24	55
Average	35.8	75.45	14.1	10.05	53.45	23.5	58
32	39.2	75.8	12.2	10.2	55.4	19	42
54	35.8	74.4	12.7	10.6	54.5	18	63
Average	37.5	75.1	12.45	10.4	54.95	18.5	52.5
33	36.7	73.9	12.5	10	55.2	20	46
69	38.8	78.2	13.5	9.3	55.3	24	57
Average	37.75	76.05	13	9.65	55.25	22	51.5
34	35	76.6	12.2	10.7	54.8	18	59
92	32.9	70	13.7	10.2	54.5	20	55
Average	33.95	73.3	12.95	10.45	54.65	19	57
35	36.5	75	12.4	10.4	55.2	19	46
89	35.6	76.8	13.5	10.6	53.8	24	63
Average	36.05	75.9	12.95	10.5	54.5	21.5	54.5
36	41.8	73.8	12.1	10.8	54.8	17	58
78	33.6	72.8	14.8	9.7	54.3	25	62
Average	37.7	73.3	13.45	10.25	54.55	21	60
37	39.7	79.8	11.3	9.3	56.4	16	44
63	37.7	77.6	11.8	10	56.3	19	52
Average	38.7	78.7	11.55	9.65	56.35	17.5	48
38	38.5	77.8	12.3	9.4	54.7	23	56
51	32	70.7	13.1	10.7	53.3	24	51
Average	35.25	74.25	12.7	10.05	54	23.5	53.5
39	39.7	76.8	12.7	10.8	54.2	19	56
88	38.4	77.3	11.9	9.7	55.4	18	52
Average	39.05	77.05	12.3	10.25	54.8	18.5	54

40	36.6	73.8	12.8	10.8	55.2	19	54
74	35.8	73.1	14.5	10.4	53.7	24	66
Average	36.2	73.45	13.65	10.6	54.45	21.5	60
41	36.2	77.4	13.8	10.4	53.8	25	62
62	34.3	72.9	12.9	10.3	55.1	20	57
Average	35.25	75.15	13.35	10.35	54.45	22.5	59.5
42	44.4	75.6	14	10.4	52.8	23	59
98	47.2	80.2	16.3	9.6	51	29	74
Average	45.8	77.9	15.15	10	51.9	26	66.5
43	42.6	75.4	15.1	10.1	53	28	71
68	44.3	78.6	14.2	9.8	54.2	23	61
Average	43.45	77	14.65	9.95	53.6	25.5	66
44	34	72.1	15.2	9.9	53.2	28	72
52	36.7	76.2	11.7	9.6	56.7	18	31
Average	35.35	74.15	13.45	9.75	54.95	23	51.5
45	37.2	74.3	14	9.5	54	23	57
93	40.2	76.5	13.9	9.6	54.3	23	70
Average	38.7	75.4	13.95	9.55	54.15	23	63.5
46	36.6	75.3	14	10.7	53.2	23	70
55	33.5	74.9	12.5	9.6	55	21	52
Average	35.05	75.1	13.25	10.15	54.1	22	61
47	36	72.9	12.6	10.5	55.1	21	49
60	36.7	75.2	14.6	10.1	53.2	26	67
Average	36.35	74.05	13.6	10.3	54.15	23.5	58
48	42.1	75.2	12.6	9.8	55.6	21	56
81	38.1	73.3	14.7	10.5	51.9	28	76
Average	40.1	74.25	13.65	10.15	53.75	24.5	66
49	48.7	76.8	11	10.3	56.3	16	46
73	43.5	75.6	13.2	10.3	53.6	22	56
Average	46.1	76.2	12.1	10.3	54.95	19	51
50	36.9	73.1	14.8	10.3	52.7	29	74
66	38.5	76.6	13.5	9.4	55.5	21	48
Average	37.7	74.85	14.15	9.85	54.1	25	61

PUWYT (Non Coded) 2019-20

Table 76: No. of Samples = 100

Plot	1000G/WT	TEST WT	PROTEIN	MOISTURE	STARCH	GLUTEN	Zeleny

1	36.5	72.6	14.1	10.6	53.5	25	68
95	32.9	75.7	14	10.8	53.8	25	55
Average	34.7	74.15	14.05	10.7	53.65	25	61.5
2	33.8	72.8	14.5	11	51.7	25	72
76	29	70	14.9	10.6	51.5	27	73
Average	31.4	71.4	14.7	10.8	51.6	26	72.5
3	32.5	71.2	13.4	10.2	55.7	26	52
100	32.6	74.3	15.5	10.7	51.3	28	74
Average	32.55	72.75	14.45	10.45	53.5	27	63
4	41.1	74.2	12.3	10.5	54.2	21	43
56	35.5	75.4	15.4	10.2	52.2	28	70
Average	38.3	74.8	13.85	10.35	53.2	24.5	56.5
5	37.9	77.1	14.1	10.2	53.9	25	49
71	36.2	75.7	14.1	10	55.1	26	52
Average	37.05	76.4	14.1	10.1	54.5	25.5	50.5
6	43	73.3	13.4	11	51.8	21	64
96	40.7	76.6	13.6	10.4	54.8	25	54
Average	41.85	74.95	13.5	10.7	53.3	23	59
7	37.6	74.2	14.6	10.5	52.3	25	52
91	39.7	74.1	13.3	10.2	54.7	22	49
Average	38.65	74.15	13.95	10.35	53.5	23.5	50.5
8	38.1	72.4	14.2	10.2	53.9	26	51
79	33.7	72.6	15.2	10.2	54.2	28	51
Average	35.9	72.5	14.7	10.2	54.05	27	51
9	39	72.9	15	10.6	52.4	28	63
83	40.2	72.4	14.1	10.3	53.2	24	51
Average	39.6	72.65	14.55	10.45	52.8	26	57
10	39.1	77.3	14.1	10.5	52.8	26	68
53	35	74.4	14.6	10.4	53	26	68
Average	37.05	75.85	14.35	10.45	52.9	26	68
11	38.6	75.8	14.4	9.6	54.9	27	53
97	41	75	14.8	10.1	53.6	27	63
Average	39.8	75.4	14.6	9.85	54.25	27	58
12	37.6	75.4	13.6	10.4	52.6	28	58
80	40	75.7	14.3	9.4	54.6	27	55
Average	38.8	75.55	13.95	9.9	53.6	27.5	56.5
13	33	73.9	14.6	10.7	52.5	26	67
72	34.1	70.2	14.3	10.7	54.1	27	74
Average	33.55	72.05	14.45	10.7	53.3	26.5	70.5

14	33.7	74.2	13.9	10.6	53.8	25	49
67	34.2	73.3	14.9	10.5	52.4	27	69
Average	33.95	73.75	14.4	10.55	53.1	26	59
15	33.3	71.3	15.6	10.3	52.1	27	66
90	33.2	72.6	15.5	10.8	52	28	69
Average	33.25	71.95	15.55	10.55	52.05	27.5	67.5
16	31.8	72.7	14.8	10.3	53.2	26	57
70	33.3	73.7	14.6	9.8	51.5	27	57
Average	32.55	73.2	14.7	10.05	52.35	26.5	57
17	36.2	75.6	14.6	10.5	53.5	28	58
61	39	76.1	13.6	10.6	53.6	24	52
Average	37.6	75.85	14.1	10.55	53.55	26	55
18	33.3	74.3	14.9	10.5	53.2	28	60
77	32.1	76.2	15.3	9.9	53.3	31	61
Average	32.7	75.25	15.1	10.2	53.25	29.5	60.5
19	38.1	72.4	15.2	10.3	53.2	30	60
58	38.3	74.3	15.2	10.4	53.2	30	62
Average	38.2	73.35	15.2	10.35	53.2	30	61
20	35.5	72.5	14.4	10.4	53.4	27	56
82	35.1	71.7	14	10.5	53.5	26	58
Average	35.3	72.1	14.2	10.45	53.45	26.5	57
21	36.9	78.2	13.6	9.8	55.2	23	56
94	36.7	78.8	13.8	10.6	54.6	23	65
Average	36.8	78.5	13.7	10.2	54.9	23	60.5
22	36.4	75.1	14.4	10.5	52.7	27	67
85	35.4	75.1	14.3	10	54.6	28	55
Average	35.9	75.1	14.35	10.25	53.65	27.5	61
23	37.3	77.1	13.8	10	55.1	25	50
86	36.8	75.7	14.2	10.1	53.5	25	58
Average	37.05	76.4	14	10.05	54.3	25	54
24	35.3	74.5	14.8	10.1	53.6	26	54
75	31.5	76.9	14	10.8	53.3	24	62
Average	33.4	75.7	14.4	10.45	53.45	25	58
25	38.8	73.2	15.8	10.5	50.5	30	73
65	40.1	74.2	15.6	10.5	51.2	29	74
Average	39.45	73.7	15.7	10.5	50.85	29.5	73.5
26	37.6	69.38	14.6	10.2	56.4	28	57
87	32.9	76	14.1	10.4	53.3	23	49
Average	35.25	72.69	14.35	10.3	54.85	25.5	53

27	34.3	75.9	13.3	10.6	54.3	23	47
64	35.2	75.1	13.4	10.9	52.9	22	61
Average	34.75	75.5	13.35	10.75	53.6	22.5	54
28	38.3	74.4	14.3	10.5	52.9	24	64
84	34.5	73	14.5	10	53.7	27	53
Average	36.4	73.7	14.4	10.25	53.3	25.5	58.5
29	41.1	74.8	14.8	10.3	53.4	27	58
57	35.7	74.8	14.9	10.6	53.1	29	67
Average	38.4	74.8	14.85	10.45	53.25	28	62.5
30	34.1	73.9	14.2	10.2	53.8	26	53
99	35.8	72.9	14.6	10.2	55.6	28	59
Average	34.95	73.4	14.4	10.2	54.7	27	56
31	39.1	76.2	14.5	10.9	54.6	25	70
59	37.4	74.6	13.9	10.8	52.9	23	62
Average	38.25	75.4	14.2	10.85	53.75	24	66
32	36.3	74.4	13.9	10.5	53.7	25	69
54	33.7	77.6	14.9	10.6	52.4	26	70
Average	35	76	14.4	10.55	53.05	25.5	69.5
33	36.9	73.2	14.6	10.9	52.4	26	67
69	41	76.4	15.3	10.9	52.5	29	73
Average	38.95	74.8	14.95	10.9	52.45	27.5	70
34	33	73.4	13.3	10.5	53	22	63
92	34.6	72.6	13.5	10.6	53.8	24	58
Average	33.8	73	13.4	10.55	53.4	23	60.5
35	34.5	75.3	14.7	10.8	52.2	27	65
89	34.9	75.2	14.3	10.1	54.3	27	56
Average	34.7	75.25	14.5	10.45	53.25	27	60.5
36	37.6	73.1	14.6	10.6	52.6	25	69
78	37.4	74.8	15	10.6	52.4	26	64
Average	37.5	73.95	14.8	10.6	52.5	25.5	66.5
37	34.2	75.8	12.7	10.7	52.1	21	43
63	32.6	76.9	12.9	10.9	54.2	22	60
Average	33.4	76.35	12.8	10.8	53.15	21.5	51.5
38	30.8	75.7	13.5	10.5	53.6	25	49
51	33.5	74.1	14.2	10.4	51.2	27	67
Average	32.15	74.9	13.85	10.45	52.4	26	58
39	35.4	74.8	13.7	10.3	53.4	24	63
88	33.5	71.5	14.9	10.2	53.1	28	60
Average	34.45	73.15	14.3	10.25	53.25	26	61.5

40	35.8	75.6	13.9	10.6	53.6	24	68
74	33.8	70	14	10.6	53	25	64
Average	34.8	72.8	13.95	10.6	53.3	24.5	66
41	37.8	76.3	14.7	10.8	52.3	27	69
62	40.1	77.2	13.9	11	53.4	25	56
Average	38.95	76.75	14.3	10.9	52.85	26	62.5
42	33.8	74.9	15	10.1	53.6	29	59
98	42.6	74.2	14.6	10.5	52.6	28	68
Average	38.2	74.55	14.8	10.3	53.1	28.5	63.5
43	43.8	76.9	15.6	10.5	52.3	29	72
68	43.6	73.8	15.4	10.6	52	29	72
Average	43.7	75.35	15.5	10.55	52.15	29	72
44	35.9	74.9	14.6	10.2	54.6	28	57
52	34.8	73.2	14.4	10.6	53.8	26	62
Average	35.35	74.05	14.5	10.4	54.2	27	59.5
45	37.6	76.7	14	10.7	53.7	24	56
93	32.8	75.1	13.4	10.3	54.4	24	56
Average	35.2	75.9	13.7	10.5	54.05	24	56
46	42.9	77.7	14.5	10.7	52.7	27	61
55	40	76.3	16.3	10.1	51.6	33	73
Average	41.45	77	15.4	10.4	52.15	30	67
47	34.9	76.1	14.1	10.5	51.4	26	59
60	36.5	75.9	13.7	10.2	54.6	25	54
Average	35.7	76	13.9	10.35	53	25.5	56.5
48	37.2	75.2	14.6	10.1	53.7	29	56
81	37.4	73.1	14.6	10.6	52.7	27	67
Average	37.3	74.15	14.6	10.35	53.2	28	61.5
49	38.1	75.9	13	11	52.7	22	54
73	42.3	78.3	13.4	10.8	52.5	23	60
Average	40.2	77.1	13.2	10.9	52.6	22.5	57
50	36.2	75.7	14.5	10	53.9	29	58
66	38.2	75.1	15.2	10.3	53	30	64
Average	37.2	75.4	14.85	10.15	53.45	29.5	61

EFFECT OF PLANTING TIME ON GRAIN QUALITY TRAITS (2019-20)

Fourteen lines/varieties of wheat were grown in three replicates at 8 planting dates each with 10 days interval. Among all yield controlling parameters HYT-55-33 scored best giving highest values of thousand grain weight as well as test weight followed by V-16164 in case of thousand grain weight and V-16157 in case of test weight. Highest value of thousand grain weight as well as test weight was observed in first date of sowing i.e. 20th October.

Tables 77: Thousand Grain weight (g)

Line/Variety	D1	D2	D3	D4	D5	D6	D7	D8
FSD-08	36.2	35.4	29.7	30.3	32.7	27.4	27.7	25.1
Ujala-16	41.6	40.4	34.1	36.2	34.2	30.3	28.8	22.5
Anaj-17	36.7	34.5	29.7	29.7	29.7	28.8	26.1	26.3
Akbar-19	41.3	39.8	34.7	31.9	36.6	32.8	32.7	29.7
V-16005	38.4	38.1	32.1	35.4	33.6	33.4	32.5	25.7
V-17179	43.3	39.9	36.2	35.7	38.1	35.8	36.4	33.4
V-17175	37.8	36.5	33.3	34.5	33.7	33.4	34.1	31.0
V-16157	39.2	40.9	33.7	35.0	34.3	31.3	29.3	27.0
V-17157	38.6	38.4	32.0	34.5	37.6	35.0	33.7	30.5
V-17189	41.7	42.9	35.6	38.0	39.2	35.1	37.0	32.0
V-16024	41.3	39.0	33.3	35.4	36.1	33.5	32.0	28.2
V-16164	40.8	43.4	37.2	37.5	37.1	36.1	34.0	33.1
V-12304	42.6	39.1	33.3	33.0	35.3	32.9	30.9	28.6
HYT-55-33	44.3	39.1	37.3	36.4	36.4	37.0	35.4	31.3

Table 78:Test Weight (kg/hL)

Line/Variety	D1	D2	D3	D4	D5	D6	D7	D8
FSD-08	75.6	74.1	72.3	71.5	74.7	71.8	73.9	67.7
Ujala-16	74.2	75.9	76.4	74.6	74.2	72.4	71.9	67.2
Anaj-17	75.4	74.1	72.1	72.2	72.6	70.4	71.7	69.5
Akbar-19	75.0	73.8	72.1	71.9	75.6	72.9	73.7	69.1
V-16005	76.6	73.6	76.0	74.1	75.4	72.7	74.7	69.7
V-17179	74.9	77.3	76.2	74.1	77.5	74.4	77.7	71.4
V-17175	78.4	75.1	75.7	75.8	76.4	74.4	75.8	70.4
V-16157	78.7	76.4	76.0	75.0	77.3	76.2	76.5	71.4
V-17157	75.4	72.2	72.3	74.7	76.0	72.0	73.8	66.9
V-17189	75.2	76.4	73.8	76.4	76.3	74.6	76.3	71.2
V-16024	73.7	75.8	73.1	74.2	76.1	75.9	76.2	72.4
V-16164	74.6	73.9	73.2	73.7	74.9	73.5	73.9	69.7
V-12304	78.7	77.7	73.8	75.6	78.0	76.5	78.3	72.6
HYT-55-33	79.4	75.3	75.5	78.4	77.5	76.0	77.4	72.5

Table 79: Protein (%)

Line/Variety	D1	D2	D3	D4	D5	D6	D7	D8
FSD-08	14.43	14.53	15.17	14.50	14.20	13.87	13.93	14.07
Ujala-16	14.80	15.70	15.10	15.23	14.70	13.23	13.10	13.23
Anaj-17	13.37	13.97	14.77	14.20	13.33	12.87	12.87	13.33
Akbar-19	13.10	13.53	13.97	14.17	13.57	12.67	12.27	12.53
V-16005	14.00	14.87	15.17	14.57	14.23	13.30	13.63	13.67
V-17179	13.70	14.30	14.43	14.80	13.50	13.43	13.60	13.10
V-17175	14.40	14.90	15.30	15.50	13.83	13.10	13.27	13.33
V-16157	15.33	16.10	15.70	15.33	14.73	13.83	14.23	14.17
V-17157	15.20	15.67	15.53	15.70	14.83	14.03	14.03	14.37
V-17189	15.40	16.07	15.73	15.70	15.67	14.53	14.53	14.43
V-16024	14.67	15.80	15.47	15.43	15.07	14.03	14.07	13.90
V-16164	15.57	16.00	16.03	15.77	14.77	13.93	13.63	14.10
V-12304	15.17	15.67	15.80	15.73	14.83	13.67	13.40	13.70
HYT-55-33	15.53	16.17	15.67	16.20	15.33	15.53	15.37	15.33

Table 80: IMPACT OF SOWING TIME ON PHYTIC ACID, IRON AND ZINC CONTENTS IN WHEAT GRAIN (2019-20)

Varieties	Iron Content (ppm)			Zinc Content (ppm)			Phytic Acid Content (%)		
	D1	D2	D3	D1	D2	D3	D1	D2	D3
FSD-08	135	140	143	31.1	31.0	33.2	1.72	1.86	1.90
Anaj-17	136	142	142	30.2	33.1	33.0	1.75	1.78	2.05
Akbar-19	137	141	142	31.5	33.7	32.7	1.80	1.88	2.05
HYT-55-33	135	138	144	32.5	32.2	32.7	1.80	1.91	1.97

PREPARATION OF BREAD FROM ALEURON FLOUR (2019-20)

Three Wheat Cultivars were processed to get aleuron flour. This was further analyzed for sedimentation value, rheology study, color analysis and bread baking potential. Results of sedimentation are given but other analyses are in process.

Table 81: Sedimentation values of wheat varities

Wheat Variety	Sedimentation value (ml)
Ujala-16	63
Anaj-17	55

Akbar-19	56

IMPACT OF TEMPERING CONDITIONS ON MILLING YIELD AND RHEOLOGY OF FLOUR (2019-20)

Three promising wheat lines were selected for the said study. Among all, Akbar-19 gave maximum flour yield when it was tempered at 15% moisture content for 16 hours before milling.

Table 82: Impact Of Tempering Conditions On Milling Yield And Rheology Of Flour

Tempering Conditions		Flour Yield (%)		
		Varieties/ Lines		
Time (Hours)	Moisture (%)	Anaj- 17	Akbar-19	HYT-55-33
8	14	68	68	68
	15	70	71	70
	16	67	67	68
16	14	69	69	69
	15	71	72	71
	16	66	66	65
24	14	66	67	66
	15	65	65	66
	16	64	65	63

Scrutinizing the effect of Various Fertilizer Treatments on the Quality Wheat Grains

Ninety-six (96) grain samples were analyzed for the effect of four different fertilizer treatments and combinations at a specific planting date on wheat grain quality of eight advanced lines and varieties. They were tested for grain quality parameters, esp. grain weight (using seed counter & electric balance), test weight (through test weight/bushel weight apparatus), starch, gluten and protein contents (using Omeg Analyzer).

Fertilizer Levels NPK (kg/ha)
F_1 =0 – 0 – 0 **F_2**= 90 – 60 – 60 **F_3**= 120 – 90 – 60 **F_4**= 150 – 120 – 60

Table 83: Impact of Various Fertilizer Treatments on Wheat Grain Quality (2019-20)

Varieties/Lines	Parameters	Treatments				Varietal Average
		F1	F2	F3	F4	
Fsd-08	1000 grain wt. g	34.2	32.5	33.4	34.5	33.7
	Test weight kg/hL	74.4	72.4	72.4	72.4	72.9

	Protein %	13.8	14.5	14.4	14.6	14.3
	1000 grain wt. g	37.9	36.8	35.8	35.2	36.4
	Test weight kg/hL	73.2	73.8	73.9	73.8	73.7
V-16005	**Protein %**	14	14.9	14.7	14.8	14.6
	1000 grain wt. g	35.8	36.9	36.2	35.8	36.2
	Test weight kg/hL	73.2	75.3	75.7	75.4	74.9
V-16157	**Protein %**	15.2	15.6	15.6	15.7	15.5
	1000 grain wt. g	36.9	36.5	35.1	37.1	36.4
	Test weight kg/hL	73.8	74.0	74.9	74.6	74.3
V-17175	**Protein %**	14.4	14.6	14.5	14.8	14.6
	1000 grain wt. g	38.9	38.9	40.0	39.0	39.2
	Test weight kg/hL	72.6	72.6	72.3	72.6	72.5
V-17179	**Protein %**	13.5	14.3	14.2	14.5	14.1
	1000 grain wt. g	39.1	36.8	39.0	37.1	38.0
	Test weight kg/hL	70.9	74.5	74.1	71.3	72.7
V-17157	**Protein %**	14.3	15.2	15	15	14.9
	1000 grain wt. g	41.0	39.1	40.5	40.6	40.3
	Test weight kg/hL	75.9	74.1	73.0	73.1	74.0
V-17189	**Protein %**	14.5	14.6	15.4	15.6	15.0
	1000 grain wt. g	41.0	38.9	40.5	40.1	40.1
	Test weight kg/hL	76.4	74.1	77.2	76.3	76.0
HYT-55-33	**Protein %**	15.1	15.7	15.6	15.8	15.6

Assessing the results, HYT-55-33, V-17189 and V-17179 gave excelling results in all the fertilizer treatments ranging from 38.9-41.0 g), followed by V-17157. F1 and F3 gave better results in terms of 1000 grain weight. HYT-55-33 and V-16157 performed exceptional in terms of test weight among all the fertilizer treatments and V-17175 and V-17189 followed nearby. Test weight revealed good results in all treatments, slightly excelling in F3.

Fsd-08 gave meager performance in both 1000 grain weight and test weight.

V-16157 and HYT-55-33 gave excelling protein results upto 15.8%, followed by V-17189 and V-17175. Protein apparently increased with treatments.

Assessment of Quality Traits in Advanced Lines of Barley

Two hundred and sixteen (216) barley lines/varieties with three replicates under Punjab Uniform Barley Yield Trial, Barley Rainfed and Irrigated Yield Trials and Barley Sowing Date Trials (2019-20) were analyzed for quality traits (1000 kernel weight, test weight and protein content).

The following tables give a detailed numeric description of the results that were analyzed:

Table 84: Quality Results of Punjab Uniform Barley Yield Trial (PUBYT) 2019-20

Varieties/Lines	1000 grain wt.(g)	Test wt. kg/hL	Protein %
B-17013	38.8	61.2	12.0
B-16035	41.9	65.3	11.9
B-17009	45.3	64.0	12.7
B-17011	39.4	59.5	11.3
B-17010	41.4	60.1	10.7
B-15012	41.5	61.6	12.3
B-16020	38.7	58.9	11.8
B-17034	38.2	61.5	12.0
B-17.16	40.0	63.9	11.9
LHR-AGB-1	39.2	61.1	10.5
SULTAN-17	40.1	64.5	9.8
JAU-87	40.6	61.7	12.3

Results reveal that among the Punjab Uniform Barley Yield Trials (PUBYT), the uppermost 1000 grain weight recorded was of B-17009 with 45.30g, followed by B-16035 showing 41.9g. Least was of B-17034 (38.2g). Test weight showed better results as compared to 1000 grain weight. Highest test weight recorded was of B-16035 (65.8 kg/hL) B-17009 gave the highest protein content (12.7%), least was of Sultan-17 (9.8%).

Table 85: Quality Results of Barley Rain Fed Trial 2019-20

Varieties/Lines	1000 grain wt.(g)	Test wt. kg/hL	Protein %
B-16011	45.4	54.8	13.9
B-15018	42.1	54.4	12.6
B-15035	44.9	59.1	13.4
B-17039	37.5	62.9	12.5
B-15006	36.7	55.8	13.3
B-14003	38.8	50.1	13.0
B-14035	39.4	50.0	14.4
B-16035	41.1	54.8	12.7
B-19029	36.8	58.6	14.7
B-19030	39.0	52.4	14.3
JAU-17	42.0	56.0	14.3
JAU-87	41.9	54.4	12.5

Reviewing the Rain fed results; the highest 1000 grain weight was of B-16011 i.e. 45.4 g, followed by B-15035 (44.9g). Least B-15035 1000 grain weight recorded was of B-15006 (36.7g). B-17039 revealed the highest test weight i.e. 62.9 kg/hL and least was of B-14035 (50.0 kg/hL), while protein content was maximum in B-19029 (14.7%), followed by B-14035 (14.4%).

Table 86: Quality parameter Results of Barley Irrigated Trial 2019-20

Varieties/Lines	1000 grain wt.(g)	Test wt. kg/hL	Protein %
B-16011	29.7	59.2	12.4
B-15018	39.3	52.3	12.7
B-15035	39.6	60.4	13.3
B-17039	25.3	61.6	12.5
B-15006	33.8	59.8	14.2
B-14003	38.8	52.0	12.9
B-14035	37.4	52.6	14.4
B-16035	38.2	58.2	13.2
B-19029	38.4	69.9	12.7
B-19030	32.8	52.8	13.3
JAU-17	36.2	53.2	14.3
JAU-87	38.9	55.5	13.3

Estimating the outcomes of the Irrigated samples, B-15035 revealed highest 1000 grain weight (39.6 g) followed by B-15018 (39.3 g). Maximum test weight recorded was of B-19029 i.e. 69.9 kg/hL

As compared to Rain fed, protein content in the irrigated barley lines/varieties was overall slightly lower. Protein content was highest in B-14035 (14.4%) followed by B-15006 (14.2%).

Table 87: Quality Results of Barley Sowing Date (D1) Trial 2019-20

Varieties/Lines	1000 grain wt.(g)	Test wt. kg/hL	Protein %
B-15012	37.4	59.0	11.2
B-15018	41.4	52.3	11.0
B-15035	46.8	64.5	11.4
B-17039	31.7	59.4	10.2
B-15006	34.0	59.3	12.4
B-14003	36.7	51.7	9.6
B-14035	42.4	52.7	10.8
B-16035	39.6	55.6	9.9

B-17016	42.3	59.7	11.3
JAU-17	45.7	59.6	10.9
SULTAN-17	39.1	62.6	10.5
JAU-87	38.8	55.6	10.7

Studying the Sowing dates Trial, B-15035 showed the highest 1000 grain weight i.e. 47.5 g and excelling in all sowing dates was followed by Jau-17 giving good results in 1000 grain weight overall. D3 gave the highest test weight results. B- 15035 (64.5kg/hL) gave the highest test weight at D1 followed by B-17016 with at D2 and D3 respectively

Protein content increased along the dates from D1 to D3, with B-15006 revealing the highest protein content i.e. 14.4%

Table 88: Quality Results of Barley Sowing Date (D2) Trial 2019-20

Varieties/Lines	1000 grain wt.(g)	Test wt. kg/hL	Protein %
B-15012	38.8	54.8	11.0
B-15018	39.8	53.6	12.5
B-15035	46.7	61.7	12.6
B-17039	37.4	59.9	11.3
B-15006	35.4	56.2	12.9
B-14003	41.7	55.2	11.9
B-14035	41.8	52.7	12.1
B-16035	41.3	54.9	13.6
B-17016	40.7	63.7	14.0
JAU-17	44.7	54.8	11.1
SULTAN-17	37.7	51.2	12.8
JAU-87	39.8	56.2	10.8

Table 89: Quality Results of Barley Sowing Date (D3) Trial 2019-20

Varieties/Lines	1000 grain wt.(g)	Test wt. kg/hL	Protein %
B-15012	37.6	56.0	11.8
B-15018	40.4	54.6	12.4
B-15035	47.5	61.4	12.8
B-17039	36.7	60.4	12.7
B-15006	35.0	59.2	14.4
B-14003	40.1	55.9	12.7
B-14035	40.2	52.1	13.4

B-16035	40.5	57.5	12.3
B-17016	44.1	62.9	14.8
JAU-17	45.8	61.0	12.9
SULTAN-17	39.3	61.2	11.9
JAU-87	40.1	60.4	11.4

Publications:

Nutritive and Technological Substitute to the Traditional Pakistani Pasta Industry with Durum Wheat Pasta Abstract accepted and presented for the first International Wheat Congress in Saskatoon, Canada, July 21 – 26, 2019.

Quantitative Valuation and Qualitative Confirmation of Selective Micronutrients in Bread Wheat Genotypes via Multivariate Scrutiny. Accepted and presented in Ist International Wheat Congress in Saskatoon, Canada from July 21-26, 2019.

Amalgamation of Aleurone Layer in Wheat Flour for the Improvement of End Use Nutritional Quality of Flat Bread Accepted and presented in "International Wheat Congress", Saskatoon, Canada, July 21-26, 2019.

Tabbassum, M.I., M.I.Javed, I.Nabi, N. Ahmad and A. Mahmood (2019). A face for enhancing cane and sugar yield in Pakistan. Global Scientific Journal (GSJ).7(3):670-687. (Online).ISSN.2320-9186.

Muhammad, S. M. Sajjad, M. Shahid and A. Rehman (2019). Genome wide association analysis for stripe rust resistance in spring wheat (*T. aestivum L*) germplasm. J. of integrative Agri. 18(0): 2-10.

Urdu Articles

Newly developed 33 vars at AARI Daily Express., Sun magazine, OCT. 6, 2019.
AARI released 33 new vars. Kisan world Oct. 2019.

Mummy daddy Gandum se Inqulab Daily dunya newspaper Dec.7, 2019

Trainings:

Training of master trainers for wheat crop was organized by and held at wheat research institute, Faisalabad. Scientist of wheat research delivered lectures on all aspects of wheat crop.
Two officers participated in local trainings at National Centre for Rural Development, Islamabad.
One officer received training at Nuclear Institute for Agriculture and Biology, Faisalabad.

Two officers participated in three days local training entitled “effective communication and presentation skills” at National Centre for Rural Development, Islamabad.
One officer received 14 days training entitled “advance analytical techniques” at Nuclear Institute for Agriculture and Biology, Faisalabad.
One officer participated as resource person in three days workshop organized by FAO, Islamabad at main library AARI, and Faisalabad.
Two officers participated in five days training program “biochemical and molecular techniques in plant breeding organized by Nuclear Institute for Agriculture and Biology, Faisalabad.
Three officers participated in two days training program (ISO-17025:2017) organized by Rapid Soil Fertility Survey and Soil testing Institute, Lahore).
One officer participated in four weeks financial management training conducted by university of Agriculture, Faisalabad.
Two officers participated in two days local training at National Institute for Biotechnology and Genetic Engineering, Faisalabad.
Four officers completed four weeks finance, administration, management and e-governance training conducted by university of Agriculture, Faisalabad.

Miscellaneous:

Sixty students from different universities are doing internship under the supervision of WRI, Faisalabad’s scientists.

Wheat rust surveillance was conducted to observe rust existence and wheat crop condition. The activity was conducted in 96 different locations of Punjab districts.

Travelling Wheat Seminar with concluding session was conducted at Wheat Research Institute, Faisalabad.