

# **ANNUAL DETAILED TECHNICAL REPORT FOR THE YEAR 2020-21**



**REGIONAL AGRICULTURAL RESEARCH INSTITUTE,  
BAHAWALPUR**

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## INTRODUCTION

Regional Agricultural Research Institute, Bahawalpur was upgraded in 1987, however, it was established as Agriculture Research Station in 1950 at Khanpur, District Rahim Yar Khan and shifted to Bahawalpur during 1969. At this Institute, crop breeding efforts are underway to develop high yielding varieties of wheat, pulses, millet, sorghum and oilseed, suitable for irrigated as well as low rain or arid-climatic zone of Southern Punjab. Wheat is the main food crop of Pakistan, being cultivated on about nine million hectares in all over the country. Punjab is the main wheat producing province of the country (6.55 mh) that shares 91% of area under irrigated conditions and 9% under rained conditions. A number of high yielding, drought tolerant, disease and insect pest resistant wheat and other crop varieties along with their production and protection technologies have been released for general cultivation in the region. The Institute has released fourteen wheat, two mungbean, one sorghum, two pearl millet, one raya (Mustard) and one chickpea varieties up till now. The wheat variety Ghazi-19 is the most cultivated variety in Southern Punjab. This variety is high yielder as well as tolerant to rust and drought. Two advance line of wheat (BF-1705 & 172190) are in final stage of approval. Dozens of advance lines of various crops including wheat (1601 & 1807), oilseed BRJ-1304 & BRJ-1458) and pulses (BR-446 & BRC-474) are in pipeline. The institute is also focusing on evolution of crop varieties resilient to drought and heat stresses under climate change scenario.

## ORGANIZATION

**Head of institute : Dr. Lal Hussain Akhtar, Principal Scientist**

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### BUDGET (2020-21)

Budget PC21018- Agriculture	Allocation (Rs.)			Expenditure (Rs.)		
	Salary	Non-salary	Total	Salary	Non-salary	Total
	69748000	22495000	92243000	69779000	22485000	92264000

### INCOME

Target (Rs.)	Achievement (Rs.)
7883600	7885145

## ECONOMIC BOTANY SECTION

Wheat breeding research activities carried out during 2020-21 included hybridization, maintenance of filial generations (F<sub>1</sub>-F<sub>7</sub>), evaluation of advance strains in various categories of yield trials i.e., Preliminary, Regular, Regional, Punjab uniform wheat yield trials (PUWYT) and National uniform wheat yield trials (NUWYT). Exotic germplasm received from international research organizations like CIMMYT and ICARDA through National Coordinator (Wheat) was also tested under local conditions. Selection of desirable genotypes was made for yield testing and their inclusion in future hybridization program. Brief description of main activities performed during the year is given as under:

### 1. HYBRIDIZATION

Two crossing blocks comprising 260 genotypes were planted with an interval of 12 days on 10.11.2020 and 22.11.2020. Crossing among the suitable parents was made. More than 320 crosses were attempted. Threshing of crossed spikes is under process. The seed of crossed spikes will be further evaluated in F<sub>1</sub> and subsequent generations. Detail of crosses is given as under:

Purpose	No. of crosses attempted
High yield	130
Resistance to diseases	95
Heat and drought tolerance	75
Quality enhancement	30
<b>Total</b>	<b>320</b>

## 2. MAINTENANCE OF FILIAL GENERATIONS (F<sub>1</sub>-F<sub>7</sub>)

Filial generations from F<sub>1</sub>-F<sub>7</sub> were studied. Desirable recombinants from segregating generations were selected for further evaluation in succeeding generations. Individual plants were selected from desirable families following pedigree method. In addition, desirable lines attaining homozygosity from advance generations were individually bulked for testing in yield trials. Detail of filial generations and selection of desirable genotypes and plants is given as under:

Generation	Entries studied	Single plants selected	No. of Entries Bulked
F <sub>1</sub>	344	-	-
F <sub>2</sub>	579	592	-
F <sub>3</sub>	365	302	-
F <sub>4</sub>	463	155	22
F <sub>5</sub>	297	96	11
F <sub>6</sub>	138	36	22
F <sub>7</sub>	47	-	5
<b>Total</b>	<b>2233</b>	<b>1181</b>	<b>60</b>

## 3. SHUTTLE BREEDING

Generation advancement was done at Hazara Agri. Res Station, Kaghan during off-season to reduce the breeding period of a new variety. The selected genotypes from filial generations were sown at Kaghan during the month of June, 2020. The genotypes were harvested, threshed and planted as successive generations at RARI, Bahawalpur in normal season of 2020-21. Number of genotypes selected from filial generations planted at Kaghan during 2020 is given as under:

### i. Filial generations planted during June, 2020

Generations	No. of families	Selection
F <sub>3</sub>	81	57
F <sub>4</sub>	106	73
Total	187	130

During June, 2021, following filial generations have been planted at Kaghan which will be harvested, threshed and proceeded to subsequent stages during normal growing season 2021-22 at RARI, Bahawalpur.

### ii. Filial generations planted during June, 2021

Generations	No. of families	Selection
F <sub>3</sub>	86	Selection will be done in October, 2021
F <sub>4</sub>	73	
F <sub>5</sub>	26	
Total	185	

#### 4. STATION YIELD TRIALS

Selected genotypes from various sources (filial generations and exotic germplasm) were evaluated for yield and other characters in various yield trials as detailed under:

##### A. Preliminary yield trials (A-trials)

One hundred and thirty four (134) entries were tested in 10 normal time planted “A” trials. These trials were laid out according to RCBD with three replications and plot size of 6m<sup>2</sup>. The trials were sown on 09.11.2020 and harvested on 07.05.2021. Fertilizer @150-120-60 kg NPK ha<sup>-1</sup> was applied. In addition to Rauni, 4 irrigations were applied throughout the growth period. The data on various morphological traits were recorded. Yield data of each trial are given as under:

A-1 trial		A-2 trial		A-3 trial	
Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)
204011	5889	204016	4222	204023	4667
204010	5667	204014	3944	Ghazi-19 (check)	4556
204003	5389	204019	3889	204029	4167
204001	4833	204013	3611	204028	4000
Ghazi-19 (check)	4722	Akbar-19 (check)	3611	204024	3889
204006	4611	204018	3444	204031	3833
204004	4556	204021	3389	Akbar-19 (check)	3778
204002	3833	204017	3111	204030	3667
Akbar-19 (check)	3667	Ghazi-19 (check)	3111	204027	3556
204007	3222	204020	3000	204032	2778
204009	3222	204012	2722	204033	2667
204005	2722	204015	2667	204025	2611
204008	2500	204022	2333	204026	2556
CV = 6.4%	LSD (0.05)= 132	CV =11.2%	LSD (0.05)=157	CV =14.7%	LSD (0.05)=263

A-4 trial		A-5 trial		A-6 trial	
Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)
204044	3889	204052	4000	204065	5667
204043	3778	204048	3944	204063	4833
204042	3722	Akbar-19 (check)	3722	204064	4667
Ghazi-19 (check)	3611	204055	3444	204062	4222
204038	3500	204053	3278	204056	3611
204040	3222	Ghazi-19	3222	204066	3556

		(check)			
204035	3167	204046	3167	204059	3444
204037	3111	204049	2778	Ghazi-19 (check)	3167
Akbar-19 (check)	2944	204054	2611	204058	3111
204034	2667	204045	2278	Akbar-19 (check)	2889
204039	2444	204050	2278	204057	2667
204041	2389	204051	2167	204061	2556
204036	2167	204047	2000	204060	2333
CV =11.4%	LSD (0.05)= 174	CV =13.2%	LSD (0.05)=194	CV =9.5%	LSD (0.05)=168

A-7 trial		A-8 trial		A-9 trial		A-10 trial	
Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)
204067	4333	204079	5000	204090	4889	204110	4778
204075	3778	204078	4444	204098	4222	204104	4333
204077	3667	204083	4222	204099	4167	204106	4333
204072	3611	204080	4167	204091	3444	204115	4333
Ghazi-19 (check)	3556	204088	4000	204092	3444	204105	4111
204071	3389	204085	3889	204094	3389	204111	4111
204070	3278	204089	3722	204096	3389	204107	4056
204068	3167	204087	3500	Ghazi-19 (check)	3389	204108	3944
204074	3111	204081	3222	204100	3278	204103	3667
Akbar-19 (check)	3056	Ghazi-19 (check)	3222	204095	3167	Akbar-19 (check)	3611
204069	3000	Akbar-19 (check)	3222	Akbar-19 (check)	3056	204109	3556
204076	2500	204086	2722	204101	2833	Ghazi-19 (check)	3500
204073	2111	204084	2500	204097	2778	204112	3389
		204082	2278	204093	2333	204113	2778
				204102	2278	204114	2389
CV =10.8%	LSD (0.05)=17 3	CV=9.7%	LSD (0.05)=15 5	CV=9.4%	LSD (0.05)=157	CV=9.6%	LSD (0.05)=163

## B. Regular yield trials (B-trials)

One hundred and four (104) genotypes were tested for grain yield, disease resistance and other desirable features in regular yield trials in normal time planting. These genotypes were divided into 8 trials. These trials were laid out according to RCBD with three replications and plot size of 9m<sup>2</sup>. The

trials were sown on 12.11.2020 and harvested on 10.05.2021. Fertilizer @150-120-60 kg NPK ha<sup>-1</sup> was applied. In addition to Rauni, 4 irrigations were applied throughout the growth period. The data on various morphological traits were recorded. Yield data of each trial are given as under:

B-1 trial		B-2 trial		B-3 trial		B-4 trial	
Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)
204122	5167	204124	5611	204139	4556	Akbar-19 (check)	5000
193824	5056	Ghazi-19 (check)	4778	193856	4444	204144	4944
Akbar-19 (check)	5000	193851	4000	193870	4389	204143	4833
204120	4611	Akbar-19 (check)	3778	204133	4389	Ghazi-19 (check)	4056
Ghazi-19 (check)	4333	204129	3500	Akbar-19 (check)	4389	204146	3500
193815	4167	204126	3444	204136	4333	193887	3278
204119	3500	193850	3278	Ghazi-19 (check)	4333	193890	3278
204117	3444	204127	3222	204137	4167	204140	3278
204116	3222	204128	3222	204134	3944	193886	3111
204121	2778	204131	3222	204138	3278	204141	2778
193834	2722	204130	2667	193857	2722	204145	2778
204123	2722	193842	2556	204135	2722	204142	2667
204118	2056	204125	2444	204132	2389	193876	2611
CV =7.8%	LSD (0.05) =144	CV = 10.3%	LSD(0.05) =178	CV =9.6%	LSD (0.05) =181	CV =7.1%	LSD (0.05) =124

B-5 trial		B-6 trial		B-7 trial		B-8 trial	
Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)
193901	6167	Akbar-19 (check)	5056	204164	5611	204171	6556
193881	5667	204157	5000	193926	4389	193918	5333
204153	5500	Ghazi-19 (check)	4778	204167	4389	Ghazi-19 (check)	4833
Akbar-19 (check)	5056	204158	4611	204165	3833	204169	4722
204152	4778	204156	4500	193910	3778	204175	4222
Ghazi-19 (check)	4556	204155	4444	193916	3444	193959	3611
204150	4333	204160	4056	204163	3444	204173	3611



193895	4278	204159	4000	193924	3167	193941	3500
193896	3944	193843	3556	Ghazi-19 (check)	3111	204168	3222
204151	3944	193869	3444	204162	2611	193949	2833
204148	3556	204161	2722	Akbar-19 (check)	2611	204174	2778
204149	2889	193906	2667	204166	2444	193938	2500
204147	2556	204154	2389	193927	2111	204170	2056
CV =7%	LSD (0.05) =152	CV =9.1%	LSD (0.05) =177	CV =10.7%	LSD (0.05) =182	CV =8.9%	LSD (0.05) =167

### C. Regional yield trials

The selected genotypes from regular yield trials are further tested at various sites in the South Punjab region. The trial consisted of 11 advance strains and three check varieties (Ghazi-19, Akbar-19 and Johar-16). The trial was planted at 6 locations i.e. Bahawalpur (2, normal planting & late planting), Multan, Jahanian, Mailsi, R.Y. Khan and Alipur following RCBD with 3 replications. Average grain yield data of genotypes are given as under:

Strains	Bwp (N)	Bwp (L)	Multan (N)	R.Y.Khan (N)	Mailsi (N)	Jahanian (N)	Alipur (N)	Mean
180125	7500	6611	6167	7083	4000	5769	8333	6495
195714	7222	6350	6167	6833	3680	5556	8461	6324
180007	6611	6611	5972	9500	5500	5085	4778	6294
180026	6667	7778	6167	6833	5050	5128	5733	6194
180021	6444	7222	6139	7167	5083	4957	6278	6184
195719	6500	6944	5750	7917	4000	5000	6867	6140
Akbar-19 (Check)	5056	7056	6667	7833	4640	3889	7156	6042
Ghazi-19 (Check)	7222	6944	5889	6667	3889	5556	6100	6038
180025	6444	6389	6000	7000	5067	4957	6339	6028
Jouhar- 16 (Check)	6889	5778	5944	7417	4000	5299	6139	5924
180004	6889	6833	5472	7167	5167	5299	3778	5801
180141	6833	5694	5861	6500	3360	5256	6750	5751
180015	6111	7444	6306	5750	5000	4701	4000	5616
180126	5667	6200	5972	5500	3360	4359	4733	5113

Further selection will be done on grain basis. The selected genotypes will be tested in PUWYT during 2021-22.

### D. Punjab uniform wheat yield trials (PUWYT)

The trial was composed by the Chief Scientist, Wheat Research Institute, Faisalabad including advance strains from wheat research organizations/stations of the Punjab. Conduction of this trial in South Punjab

is the mandate of this institute. During 2020-21, the PUWYT consisting of 50 genotypes with alpha lattic design in 2 replications was conducted at 6 locations in South Punjab including Bahawalpur, Multan, Jahanian, Mailsi, Rahim Yar Khan and Alipur. Five advance lines (180003, 180059, 195715, BF-1902 and BF-1910) from this institute were included in this coded trial. Average yield data (kg/ha) of genotypes are given as under:

<b>Sr. #</b>	<b>Bwp (n)</b>	<b>Bwp (l)</b>	<b>Jahanian (n)</b>	<b>Multan (n)</b>	<b>Ry Khan (n)</b>	<b>Mailsi (n)</b>	<b>Alipur (n)</b>	<b>Mean</b>
1	5808	5750	6458	5250	4437	7351	8192	<b>6178</b>
2	6958	5083	5958	5083	4767	8458	6982	<b>6184</b>
3	6250	4325	5000	4325	5408	6423	6927	<b>5523</b>
4	5958	4708	5550	4575	4858	6577	7972	<b>5743</b>
5	6458	5542	5575	4658	5042	7429	7246	<b>5993</b>
6	6875	6292	5792	4250	4492	7351	7257	<b>6044</b>
7	5292	4292	5000	4083	4941	6655	8137	<b>5486</b>
8	6075	5992	5542	4025	5225	8322	6927	<b>6015</b>
9	6592	6167	5292	5492	4767	8335	7257	<b>6272</b>
10	6850	4667	4958	4342	4492	7661	8027	<b>5857</b>
11	7392	5033	5858	3992	5289	8125	7147	<b>6119</b>
12	5058	4225	5708	4575	4941	7815	7092	<b>5631</b>
13	7067	4750	5333	5150	4858	7583	7147	<b>5984</b>
14	6058	5467	6358	5400	4391	6345	7037	<b>5865</b>
15	6575	5350	5958	4160	5317	8429	7917	<b>6244</b>
16	6158	5517	6242	5008	5418	7583	8082	<b>6287</b>
17	6542	5967	6067	6350	4629	6887	7367	<b>6258</b>
18	6458	4658	5667	5667	4849	7274	7917	<b>6070</b>
19	6108	5292	6808	4742	4675	7583	8027	<b>6176</b>
20	6908	6200	6567	4317	4895	8125	7037	<b>6293</b>
21	6333	5817	6167	5642	4968	6577	8137	<b>6234</b>
22	6475	5667	6458	5075	5133	6577	7257	<b>6092</b>
23	6400	4317	6375	4833	4950	6345	6894	<b>5731</b>
24	6792	4758	6425	4925	5537	7196	7587	<b>6174</b>
25	6408	4867	6317	5658	4675	6036	6157	<b>5731</b>
26	5867	4599	6375	5583	5078	5958	6267	<b>5675</b>
27	6692	5342	6167	4833	5042	6732	7807	<b>6088</b>
28	6567	5583	6333	4058	5317	7583	7807	<b>6178</b>
29	6667	5108	6450	5075	4758	6577	5938	<b>5796</b>
30	6200	4083	5333	4808	5427	7196	6927	<b>5711</b>
31	6567	4892	5633	5250	5234	7659	7477	<b>6102</b>
32	5575	5300	5625	4925	5253	8125	5278	<b>5726</b>
33	6725	6233	4958	4875	4950	7506	7697	<b>6135</b>
34	6325	4492	5350	4492	4923	6500	6817	<b>5557</b>
35	6283	4925	5450	4875	5078	7196	6707	<b>5788</b>

36	6758	5500	5400	4742	4767	6485	7477	<b>5875</b>
37	6125	4958	5292	5608	4987	7119	7587	<b>5954</b>
38	6617	5658	5542	6017	5225	6717	7477	<b>6179</b>
39	6250	5642	5333	5042	4858	6423	7697	<b>5892</b>
40	6800	5667	5625	4108	4308	7661	6707	<b>5839</b>
41	5967	5525	5658	4150	5069	7274	7257	<b>5843</b>
42	6483	5507	5208	5083	5188	6577	7147	<b>5885</b>
43	7000	5458	6342	5325	4712	5571	6102	<b>5787</b>
44	6250	4667	5542	6159	4492	6113	7697	<b>5846</b>
45	7167	5517	5375	5683	5042	6887	8027	<b>6242</b>
46	6858	5642	5375	5383	4987	7351	7807	<b>6200</b>
47	7133	5650	4908	4508	5408	6504	8082	<b>6028</b>
48	6983	5542	5367	5332	4849	6685	6597	<b>5908</b>
49	6592	4733	6000	4508	4950	7042	5883	<b>5673</b>
50	6375	4300	6092	4775	5042	6810	8082	<b>5925</b>

#### **E. National uniform wheat yield trials**

This trial is composed by National Coordinator (Wheat), NARC, Islamabad. The trial consisting of new strains from all over country is conducted all over Pakistan in order to check the adaptability and stability of genotypes across various environments. During 2020-21, the trial consisting of 70 strains with alpha latic design in 2 replications was conducted at 6 locations in Southern Punjab. Four advance lines i.e. BF-1705, 172190 (2<sup>nd</sup> year in NUWYT), BF-1807 and 181601 (1<sup>st</sup> year in NUWYT) were contributed by this institute. Grain yield data (kg/ha) of genotypes is given as under:

Plot #	Bwp (N)	Bwp (L)	Khanewal (N)	Rykhan (N)	Mailsi (N)	Jahanian (N)	Alipur (N)	Mean
Replication 1								
1	5889	4667	6222	4889	6889	6778	6667	6000
2	4556	3667	4783	4667	6667	5056	4833	4890
3	4667	3889	4900	4778	5556	5167	4556	4787
4	4111	3333	4317	4667	5889	5389	4444	4593
5	4333	3889	4550	4667	6444	4778	4222	4698
6	5111	4111	5367	5000	6222	5889	4889	5227
7	5556	3333	5833	4778	5667	5667	4389	5032
8	6111	4444	6417	4667	6111	6333	6222	5758
9	4222	3778	4433	4778	4444	5222	4889	4538
10	4444	4333	4667	4667	6000	5778	5278	5024
11	5778	4444	6067	4556	5667	6111	6111	5533
12	5667	4111	5950	4778	6000	6056	5556	5445
13	5667	4222	5950	4667	5333	5389	4611	5120
14	5000	3667	5250	4778	6000	5444	5944	5155
15	5333	3889	5600	4556	5556	5944	6944	5403
16	5556	3833	5833	4667	4333	5167	6556	5135
17	4444	3344	4667	4778	5000	4722	5000	4565

18	5000	4111	5250	4667	5667	5222	5889	5115
19	5222	3778	5483	4889	6556	5167	7000	5442
20	5444	2667	5717	4667	5778	5111	6778	5166
21	6000	2944	6300	4778	5889	5667	7111	5527
22	6000	3167	6300	4889	6222	6556	6667	5686
23	5556	3433	5833	4778	5556	4833	7556	5363
24	5111	3333	5367	4667	5222	4889	7056	5092
25	5000	3667	5250	4778	5667	5444	7056	5266
26	4667	3667	4900	4667	6000	4944	4778	4803
27	5333	2889	5600	4778	5333	5722	7000	5237
28	4222	3778	4433	5333	5333	5556	6278	4990
29	4578	4278	4807	4556	5778	5778	5667	5063
30	5556	4333	5833	4000	5556	5611	5611	5214
31	5444	4111	5717	4111	5111	5833	5889	5174
32	5889	4556	6183	4333	6333	5889	5533	5531
33	4333	3778	4550	3778	5667	5667	6389	4880
34	4556	4000	4783	4222	5778	5778	6444	5080
35	4833	2611	5075	4000	4778	5167	5222	4527
36	5667	3333	5950	3889	4556	4944	6833	5025
37	4022	2889	3850	5222	5222	4444	6556	4601
38	5000	3111	5250	4333	5222	4833	6444	4885
39	5222	3778	5483	4667	5333	4944	7111	5220
40	4809	3556	5049	4222	5111	4000	5833	4654
41	5200	3722	5460	4889	5667	5444	6667	5293
42	6000	3556	6300	3667	4778	4944	7000	5178
43	6222	3222	6650	4222	4889	6722	6667	5513
44	4056	4200	4083	4556	4889	4833	7000	4802
45	4556	3300	4783	4111	5000	4000	4667	4345
46	4222	3222	4433	4778	5222	5111	6167	4737
47	4656	3000	4888	4333	5000	3833	4722	4348
48	4667	4333	4900	5111	5333	5222	6778	5192
49	4333	4178	4550	3889	5333	4500	5000	4540
50	5411	4533	5682	5444	6556	4944	7000	5653
51	5156	3667	5413	4333	5222	4667	6167	4946
52	5000	3222	5250	4222	4778	4167	5222	4552
53	5067	3311	5320	4778	4778	5167	5556	4854
54	4889	3422	5133	5222	5333	4889	5667	4937
55	5222	3844	5483	5444	5222	4778	5833	5118
56	5111	4000	5367	4667	5000	4444	5500	4870
57	4222	3322	4433	4222	4778	4833	7389	4743
58	5089	3444	5343	5222	4444	4833	6333	4959
59	5222	3778	5483	5111	5333	5278	6333	5220
60	5444	3389	5717	5333	6000	5722	7333	5563
61	5556	4111	5833	3556	6444	5333	5833	5238
62	4889	4311	5133	4333	6111	5611	7222	5373
63	5111	4167	5367	4111	6000	5722	7056	5362

64	5444	3433	5717	4889	6222	5222	6944	5410
65	5111	3722	5367	4333	4333	5111	5111	4727
66	4556	3356	4783	4778	5667	6222	6722	5155
67	4333	3222	4550	5222	4889	5944	5278	4777
68	4444	3433	4667	4333	5667	5944	5778	4895
69	5556	4111	5833	4889	4889	5444	5556	5183
70	6333	3333	6722	5000	6556	6111	6444	5786
Replication 2								
71	5556	4333	4333	4778	5222	7056	4456	5105
72	4444	3778	4667	4778	7000	5056	4967	4956
73	5000	4278	4444	4667	7000	5833	4678	5129
74	5111	3667	4550	4778	7111	5444	4567	5033
75	4556	3611	5367	4556	6667	5611	4344	4959
76	5111	3889	5833	5111	7000	6222	5022	5456
77	4833	2944	5222	4667	6889	6000	4511	5010
78	5667	4444	6111	4778	5778	5889	6400	5581
79	4044	3444	4778	4667	6111	5556	5022	4803
80	5000	4167	5367	4778	7000	6056	5422	5398
81	5222	4444	4783	4444	6667	5667	6278	5358
82	4556	3667	4550	4889	6667	5611	5711	5093
83	4667	3722	5717	4556	7000	6056	4744	5209
84	4111	4333	6300	4889	7000	5222	6111	5424
85	5333	3667	3778	4444	6889	5889	7144	5306
86	4422	3222	5333	4778	7000	5444	6744	5278
87	4556	3778	5833	4667	5667	5167	5144	4973
88	5333	4222	6417	4778	6889	5722	6056	5631
89	5667	4500	4333	4778	6667	5722	7200	5552
90	6222	4444	4111	4556	7000	5889	6967	5598
91	5000	4111	4222	4889	6667	5278	7311	5354
92	5222	4000	4444	4778	5556	4444	6856	5043
93	4556	4556	4000	4889	5889	5056	7622	5224
94	4667	3278	4000	4556	6222	5056	7256	5005
95	4111	3333	4111	5000	6444	6278	7256	5219
96	5667	3411	5600	4667	6667	6500	4911	5346
97	5333	4222	5833	4889	6667	6944	7200	5870
98	5000	3222	4556	5222	6111	4889	6456	5065
99	4833	4111	4550	4667	5778	5833	5822	5085
100	5667	3778	5367	3889	6222	5667	5767	5194
101	4022	5167	5833	4222	5889	3833	6056	5003
102	5000	4456	4667	4444	6222	4833	5689	5044
103	5222	3778	3889	3667	6111	5944	6567	5025
104	4667	3667	5111	4333	6444	6000	6622	5263
105	5756	3444	4333	3889	6111	5222	5367	4875
106	5111	3222	5667	3778	5889	5611	7022	5186
107	4556	4333	5444	4333	6778	5778	6744	5424
108	5556	4044	3889	4111	6667	5333	6622	5175

109	4444	3611	3778	4556	6556	5111	7311	5052
110	5000	3222	4556	4333	7000	5556	6000	5095
111	5222	3411	5222	4778	6222	5611	6856	5332
112	4667	2667	3778	3778	5556	4167	7200	4544
113	5111	3333	6333	4111	5778	4944	6856	5210
114	4556	3389	5111	4444	6667	5111	7200	5211
115	5322	3111	3889	4222	6333	5833	4800	4787
116	5778	3867	4222	4667	6222	5500	6344	5229
117	4833	3889	6000	4444	5889	5944	4856	5122
118	5667	4722	4222	5000	6222	4667	6967	5352
119	4011	3844	4667	4111	6222	5500	5144	4786
120	5000	4300	5000	4222	6222	4667	7200	5230
121	5222	3411	5533	4444	5889	4778	6344	5089
122	4556	3822	5111	4111	5778	4833	5367	4797
123	5556	4111	3667	4889	6111	4889	5711	4990
124	4444	4778	3889	5111	5333	4944	5822	4903
125	5000	5056	3778	5389	5778	5611	6000	5230
126	5222	4044	5833	4556	6111	6889	5656	5473
127	4878	3111	6417	4333	5778	4833	7600	5279
128	5333	3000	4556	5111	6111	5722	6511	5192
129	5111	3222	4889	5222	5444	5444	6511	5121
130	4833	3333	5833	5222	6444	4167	7544	5340
131	5667	3389	6417	3556	7111	5389	6000	5361
132	4033	3344	4433	4222	6889	6222	7422	5224
133	5000	3889	4667	4000	6778	5278	7256	5267
134	5222	3778	6067	4778	5889	6278	7144	5594
135	4444	3667	5367	4556	5667	4889	5256	4835
136	5000	3744	5833	4889	6889	6000	6911	5610
137	5222	4444	5833	5000	6111	5500	5422	5362
138	6333	3444	6417	4667	6000	5611	5944	5488
139	5778	3500	6300	5000	6000	6833	5711	5589
140	4889	3556	5044	5111	6889	6111	6622	5460

Decoded results are still awaited.

## 5. STUDY OF EXOTIC TRIALS/NURSERIES

This institute has very strong collaboration with national and international research organizations. Several exotic germplasm are received from internal research organizations including CIMMYT and ICARDA each year. The germplasm is evaluated under the climatic conditions of Bahawalpur and selected genotypes are included in yield testing and/or hybridization program. During the year 2020-21, a total of 12 trials / nurseries of bread wheat, durum wheat and barley were received. Relevant data were recorded and sent back to the concerned quarter. Better performing strains were selected for further testing and inclusion in local breeding program. Detail is given as under:

Name of Trial/Nurseries	Origin	Genotypes Tested	Genotypes Selected
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41 ESWYT	CIMMYT	50	17
11 HPYT	CIMMYT	50	15
53 <sup>th</sup> IBWSN	CIMMYT	284	40
19 HTWYT	CIMMYT	50	10
28 SAWYT	CIMMYT	50	15
10 SATYN-HEAT	CIMMYT	36	5
HYT-90	CIMMYT	90	30
15 STEMRRSN	CIMMYT	210	24
52-IDYN	CIMMYT	50	7
21-ESBWYT	ICARDA	50	13
21 <sup>ST</sup> HT-DSBWON	ICARDA	200	15
52 IDYN	CIMMYT	50	7
12 HPAN	CIMMYT	290	40
Total		1320	231

Further selection on grain basis is under process. The finally selected genotypes will be tested in yield trials and/or used in hybridization program.

## 6. MOISTURE STRESS STUDIES

### A. Regular yield trials under moisture stress

Some of the advance lines included in Regular Yield Trials 2020-21 also tested for moisture stress tolerance by growing them in absolute rainfed conditions. For this purpose, a trial consisting of 50 genotypes was planted in two replications following alpha lattice design. Two check varieties i.e. Barani-17 and Johar-16 were included in the trial for comparison. Double rouni was done for seed bed preparation. No irrigation was applied to the crop after sowing till harvesting except for the rainfall which was recorded as 26mm for the whole crop tenure. Grain yield data of six better performing lines are given as under:

Strains	Grain Yield (kg/ha)	Strains	Grain Yield (kg/ha)
204122	3371	204157	2949
204124	3248	204011	2876
193824	3170	Johar-16 (Check)	2568
204139	3148	Barani-17 (Check)	2410

### B. Exotic trials under moisture stress

Two trials / nurseries from CIMMYT and ICARDA specified for moisture stress tolerance were evaluated under absolute rainfed conditions. All the practices were same as mentioned above. Better performing genotypes were selected from both the experiments for further yield testing and inclusion in hybridization program. Yield data of some of the genotypes surpassing check varieties are given as under:

#### i. 28 SAWYT (CIMMYT)

Genotype	Grain Yield (kg/ha)	Genotype	Grain Yield (kg/ha)
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324	2583	339	2333
386	2541	348	2333
337	2500	333	2167
393	2500	Johar-16 (Check)	2000
399	2500	Barani-17 (Check)	1917

**ii. 21<sup>st</sup> HT-DT-SBWON (ICARDA)**

Genotypes	Grain Yield (kg/ha)	Genotypes	Grain Yield (kg/ha)
181	2708	22	2291
111	2500	120	2291
131	2500	180	2291
9	2291	182	2291
11	2500	Johar-16 (Check)	2083

## 7. HEAT TOLERANCE STUDIES

A set of A and B trials were sown in second week of December 2020 (late condition). The trials were laid out under RCBD fashion with three replications. Plot size of A and B trials was 6m<sup>2</sup> and 9m<sup>2</sup>, respectively. Purpose of late planting was to expose flowering and subsequent growth stages of wheat to high temperature. At grain filling stage, maximum temperature was touching 30°C. The data on various morphological traits were recorded. Grain yield data of each trial are given as under:

### A. Preliminary yield trials

A-1 trial		A-2 trial		A-3 trial	
Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)
204001	3111	204021	3389	204031	3833
204011	3000	204017	3111	204023	3056
204004	2778	Ghazi-19 (check)	3105	Ghazi-19 (check)	2978
204005	2722	204016	3056	204032	2778
Ghazi-19 (check)	2667	204020	3000	204033	2667
204010	2556	204014	2667	Akbar-19 (check)	2612
Akbar-19 (check)	2551	Akbar-19 (check)	2541	204026	2556
204003	2500	204019	2444	204029	2500
204008	2500	204018	2389	204027	2222
204007	2167	204022	2333	204028	2167
204009	2121	204012	2167	204030	2167
204006	2111	204013	2111	204025	1944



204002	1667	204015	1889	204024	1889
CV =9.5%	LSD (0.05)=179	CV =11.9%	LSD (0.05)=187	CV =7.4%	LSD (0.05)=144

A-4 trial		A-5 trial		A-6 trial	
Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)
204042	3111	204045	3108	204056	3611
204038	2389	204054	2778	204063	3333
204041	2333	204048	2667	204058	3245
204040	2167	204046	2556	Ghazi-19 (check)	3111
Ghazi-19 (check)	2000	204052	2500	204062	3000
Akbar-19 (check)	1944	Akbar-19 (check)	2389	204064	2778
204037	1889	204050	2222	Akbar-19 (check)	2556
204035	1778	204053	2056	204057	2333
204036	1667	204047	2000	204060	2321
204034	1500	204051	1988	204066	2297
204044	1222	Ghazi-19 (check)	1944	204061	2222
204039	1167	204049	1611	204065	1944
204043	1144	204055	1556	204059	1167
CV =12%	LSD (0.05)=197	CV =9.4%	LSD (0.05)=187	CV =9.2%	LSD (0.05)=179

A-7 trial		A-8 trial		A-9 trial		A-10 trial	
Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)
204068	3611	204080	3889	204090	3820	204103	3811
Ghazi-19 (check)	3556	204087	3847	204098	3728	204108	3673
204077	3500	204083	3833	204101	3506	204114	3611
204069	3444	204078	3333	Ghazi-19 (check)	3425	204115	3444
Akbar-19 (check)	3056	204085	3293	204092	2978	204106	3333
204074	3000	204089	3278	204097	2871	204110	3278
204067	2889	204081	3255	204093	2722	204109	3222
204075	2778	204088	3222	204096	2617	204105	3012
204072	2556	204086	3056	204102	2607	204113	2889
204073	2546	Ghazi-19 (check)	2833	Akbar-19 (check)	2522	204107	2778

204076	2500	204079	2778	204091	2500	204112	2444
204070	1778	204084	2500	204099	2333	204111	2389
204071	1667	204082	2278	204100	2222	Akbar-19 (check)	2319
		Akbar-19 (check)	2167	204095	2167	204104	2222
				204094	2111	Ghazi-19 (check)	1944
CV =8.3%	LSD (0.05)=120	CV =7.4%	LSD (0.05)= 144	CV =8.9%	LSD (0.05)= 165	CV =7.4%	LSD (0.05)= 148

### B. Regular yield trials

B-1 trial		B-2 trial		B-3 trial		B-4 trial	
Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)
204123	3843	204124	3194	204139	3287	204144	2638
204119	3148	193851	3056	193856	3194	Akbar-19 (check)	2611
204122	3102	Akbar-19 (check)	2963	204137	3102	204143	2546
193815	3056	204129	2824	Ghazi-19 (check)	3102	193886	2481
204120	2889	Ghazi-19 (check)	2806	193870	3046	Ghazi-19 (check)	2416
204118	2824	204125	2639	204133	3046	193887	2407
204116	2639	204127	2639	204136	2991	204140	2397
Akbar- 19 (check)	2639	204131	2639	204134	2963	204146	2395
193834	2546	204126	2546	193857	2731	193890	2370
Ghazi-19 (check)	2269	193850	2407	204135	2731	204142	2111
204117	1944	204130	2167	204132	2639	193876	1722
193824	1852	193842	2083	Akbar-19 (check)	2611	204141	1648
204121	1833	204128	1778	204138	2546	204145	1518
CV % =11	LSD (0.05)=197	CV % =10.5	LSD (0.05)=187	CV % =8.4	LSD (0.05)=165	CV % =7.1	LSD (0.05)=154

B-5 trial		B-6 trial		B-7 trial		B-8 trial	
Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)
193901	2889	Akbar-19 (check)	3056	193926	3194	204171	3111
193881	2833	204157	3009	Akbar-19 (check)	3102	204169	3009

204153	2728	204155	2889	204164	2833	Ghazi-19 (check)	2957
204150	2556	Ghazi-19 (check)	2874	Ghazi-19 (check)	2769	193938	2877
204152	2500	204156	2824	204166	2676	204170	2748
Ghazi-19 (check)	2500	193843	2639	193924	2639	204173	2639
Akbar-19 (check)	2444	204154	2627	204162	2625	204175	2574
193896	2389	204158	2600	204167	2611	193959	2556
204147	2278	193869	2546	193916	2556	193949	2389
193895	2156	204161	2500	204163	2407	193918	2324
204149	2056	193906	2463	193927	2167	193941	2222
204148	1944	204160	2435	204165	2056	204168	2167
204151	1889	204159	2407	193910	1944	204174	1852
CV =9.1%	LSD (0.05)=188	CV =10.7%	LSD (0.05)=175	CV =9.5%	LSD (0.05)=164	CV =9.5%	LSD (0.05)=197

## 8. WHEAT BIOFORTIFICATION (PARB PROJECT-904)

### A. Hybridization

Seventy four (74) crosses were attempted out of which 70 crosses were successful which will be sown in next year as F<sub>1</sub> generation.

### B. Study of filial generations (F1-F3)

Desirable recombinants from filial generations were selected for further evaluation. Detail is given as under:

Generations	Entries studied	Entries Selected
F <sub>1</sub>	88	88
F <sub>2</sub>	58	26
F <sub>3</sub>	29	14

### C. YIELD TRIALS

#### a. Preliminary yield trials (A trials)

Twenty genotypes along with two checks (Zincol-16 & Ghazi-19) were sown under three different treatments for evaluating better performing wheat genotype with high Zn & Fe contents. The treatments included in this trial were (T<sub>1</sub>) Controlled condition/genetic evaluation of wheat genotypes, (T<sub>2</sub>) Soil application of ZnSO<sub>4</sub> & FeSO<sub>4</sub> at the rate of 10 kg/ha at the time of sowing and (T<sub>3</sub>) Foliar application of 0.3% solution of ZnSO<sub>4</sub> & FeSO<sub>4</sub> at booting stage of wheat genotypes. Mean yield over three replications of the included genotypes under three treatments are given as under:

Strains	Mean yield (kg/ha)	Overall mean
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	<b>T1 (control)</b>	<b>T2 (Soil application)</b>	<b>T3 (Foliar application)</b>	<b>yield (kg/ha)</b>
BF-20105	4778	5000	5111	4963
BF-20115	4667	4944	5056	4889
Zincol-16 (check)	4667	4889	5000	4852
BF-20102	4528	4833	4944	4769
BF-20109	4611	4750	4861	4741
BF-20111	4444	4722	4944	4704
BF-20101	4472	4733	4861	4689
BF-20103	4361	4667	4778	4602
BF-20106	4333	4611	4833	4593
Ghazi-19 (check)	4278	4611	4778	4556
BF-20108	4222	4528	4722	4491
BF-20107	4139	4333	4500	4324
BF-20112	4167	4333	4444	4315
BF-20116	3944	4167	4278	4130
BF-20104	3889	4028	4222	4046
BF-20114	3833	4028	4222	4028
BF-20117	3778	3972	4167	3972
BF-20113	3667	3806	4000	3824
BF-20118	3611	3833	4028	3824
BF-20110	3389	3528	3722	3546

- T<sub>3</sub> (Foliar application) showed better results for yield and quality (Zn & Fe contents) traits in comparison with other two treatments.
- The pattern for yield and quality (Zn & Fe contents) traits were; Foliar> Soil> Control

#### **b. Regular yield trials (B trials)**

This trial was consisted on 20 genotypes (along with two checks). The purpose of this trial was to evaluate the yield performance of the selected entries. The treatments included in this trial were (T<sub>1</sub>) Controlled condition/genetic evaluation of wheat genotypes, (T<sub>2</sub>) Soil application of ZnSO<sub>4</sub> & FeSO<sub>4</sub> at the rate of 10 kg/ha at the time of sowing and (T<sub>3</sub>) Foliar application of 0.3% solution of ZnSO<sub>4</sub> & FeSO<sub>4</sub> at booting stage of wheat genotypes. Zinc, iron and protein contents of genotypes under each treatment are given as under:

<b>Strains</b>	<b>Mean yield (kg/ha)</b>			<b>Overall mean yield (kg/ha)</b>
	<b>T1 (control)</b>	<b>T2 (Soil application)</b>	<b>T3 (Foliar application)</b>	
BF-1902	5278	5389	5611	5426
BF-1903	4889	5167	5389	5148
Ghazi-19 (check)	4667	4944	5111	4907

BF-1910	4667	4889	5056	4870
BF-1901	4667	4833	4944	4815
BF-1908	4389	4667	4833	4630
BF-1907	4333	4528	4722	4528
BF-1917	4278	4500	4667	4481
BF-1904	4306	4500	4611	4472
BF-1909	4278	4444	4556	4426
BF-1905	4167	4444	4611	4407
BF-1911	4167	4444	4611	4407
BF-1906	4111	4333	4500	4315
Zincol-16 (check)	4111	4333	4500	4315
BF-1916	4167	4333	4444	4315
BF-1914	4139	4278	4444	4287
BF-1918	4000	4278	4472	4250
BF-1913	4000	4167	4333	4167
BF-1912	3778	4000	4167	3981
BF-1915	3500	3778	3889	3722

- T<sub>3</sub> (Foliar application) showed better results for yield and quality (Zn & Fe contents) traits in comparison with other two treatments.
- The pattern for yield and quality (Zn & Fe contents) traits were; Foliar> Soil> Control

#### D. Quality analysis of wheat biofortified lines

The treatments included in this trial were (T<sub>1</sub>) Controlled condition/genetic evaluation of wheat genotypes, (T<sub>2</sub>) Soil application of ZnSO<sub>4</sub> & FeSO<sub>4</sub> at the rate of 10 kg/ha at the time of sowing and (T<sub>3</sub>) Foliar application of 0.3% solution of ZnSO<sub>4</sub> & FeSO<sub>4</sub> at booting stage of wheat genotypes. Results of quality traits are given as under:

Zn (ppm)					
STRAINS	Origin	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	Mean
BF1911	F4-4130	34.48	37.20	39.08	36.92
BF1909	39 (19-ESBWYT)	32.76	36.35	40.75	36.62
BF1902	445 (9-HPYT)	34.13	36.62	38.97	36.57
Ghazi-19(check)	Ghazi-19 (check)	33.41	31.53	34.98	33.31
BF1913	F5-5014	30.55	32.17	36.02	32.91
BF1906	419 (8-SATYN)	27.68	30.18	39.18	32.35
BF1910	F4-4083	30.00	32.54	34.51	32.35
BF1917	F6-6014	28.05	32.85	35.02	31.97
BF1907	30 (19- HT-SBWYT)	28.53	30.43	36.10	31.68
BF1904	447 (9-HPYT)	26.68	29.56	37.50	31.25
BF1908	30 (19-ESBWYT)	28.32	30.70	32.15	30.39
BF1903	441 (9-HPYT)	27.00	28.85	34.84	30.23
BF1918	F6-6050	27.46	30.76	32.47	30.23
Zincol-16 (check)	Zincol-16 (check)	26.50	29.51	32.17	29.39
BF1901	427 (9-HPYT)	26.06	29.45	32.56	29.35

BF1915	F5-5110	27.82	29.44	30.38	29.21
BF1905	449 (9-HPYT)	28.29	27.94	29.73	28.65
BF1916	F5-5119	25.23	27.27	31.22	27.90
BF1914	F5-5072	22.89	28.07	32.45	27.80
BF1912	F4-4368	25.09	27.45	29.95	27.50

Fe (ppm)					
Strains	Origin	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	Mean
BF-1909	39 (19-ESBWYT)	50.15	53.50	54.25	52.63
BF-1901	427 (9-HPYT)	46.00	48.95	54.35	49.77
BF-1902	445 (9-HPYT)	43.80	45.20	52.30	47.10
BF-1905	449 (9-HPYT)	36.95	46.35	49.65	44.32
Ghazi-19 (check)	Ghazi-19 (check)	42.60	43.05	44.95	43.53
BF-1918	F6-6050	39.90	44.40	45.35	43.22
Zincol-16 (check)	Zincol-16 (check)	38.75	40.40	49.70	42.95
BF-1904	447 (9-HPYT)	36.40	41.85	47.15	41.80
BF-1912	F4-4368	36.00	41.25	46.20	41.15
BF-1906	419 (8-SATYN)	38.70	38.85	39.85	39.13
BF-1913	F5-5014	36.60	37.45	40.50	38.18
BF-1903	441 (9-HPYT)	29.10	39.75	42.60	37.15
BF-1911	F4-4130	36.50	36.35	37.65	36.83
BF-1917	F6-6014	31.25	33.45	40.10	34.93
BF-1914	F5-5072	28.25	37.55	38.00	34.60
BF-1916	F5-5119	29.15	32.85	34.30	32.10
BF-1910	F4-4083	29.15	30.60	31.35	30.37
BF-1907	30 (19- HT-SBWYT)	27.50	29.05	31.70	29.42
BF-1908	30 (19-ESBWYT)	29.30	28.75	29.25	29.10
BF-1915	F5-5110	26.05	28.95	27.20	27.40

Protein (%)		
Strains	Origin	Protein (%)
BF-1908	30 (19-ESBWYT)	15.3
BF-1909	39 (19-ESBWYT)	15.1
BF-1902	445 (9-HPYT)	14.9
BF-1901	427 (9-HPYT)	14.5
BF-1904	447 (9-HPYT)	14.5
BF-1903	441 (9-HPYT)	14.3
Ghazi-19 (check)	Ghazi-19 (check)	14.2
BF-1905	449 (9-HPYT)	14.1
BF-1906	419 (8-SATYN)	14.1
BF-1907	30 (19- HT-SBWYT)	14.1
BF-1911	F4-4130	13.8
BF-1915	F5-5110	13.7
BF-1912	F4-4368	13.5

Zincol-16 (check)	Zincol-16 (check)	13.4
BF-1914	F5-5072	13.3
BF-1917	F6-6014	13.2
BF-1910	F4-4083	12.9
BF-1913	F5-5014	12.9
BF-1916	F5-5119	12.5
BF-1918	F6-6050	12.3

## 9. SEED PRODUCTION

37 tons wheat seed of pre-basic and basic categories was produced during 2020-21. Detail is given as under:

Varieties	Seed Quantity (kg)
Aas-11	2000
Gold-16	2100
Johar-16	2000
Ghazi-19	31200
<b>Total</b>	<b>37300</b>

## OILSEED SECTION

### A. MUSTARD (*Brassica juncea*)

#### 1. Collection and maintenance of germplasm of mustard

185 entries of mustard were tested and maintained.. The trial was sown on 19.10.2020 with plot size 6m<sup>2</sup>. In addition to Rauni, 3 irrigations were applied throughout the growth period. It was harvested on 22.03.2021. Data regarding desirable traits i.e days to flowering, plant height, days to maturity, silique length, no of seeds silique<sup>-1</sup> and 1000-grain weight were recorded and are given as under:

Traits	Ranges	Traits	Ranges
Days to flowering	47-60	Silique length (cm)	06-08
Plant Height (cm)	55-120	No. of seeds silique <sup>-1</sup>	10-14
Days to maturity	130-160	1000-grain weight (g)	4.7-5.1

#### 2. Hybridization of *Brassica juncea*

Seed of six successful crosses will be sown to grow F<sub>1</sub> generation for further studies. Detail of crosses is given as under:

Crosses	Purpose
---------	---------

RJ-1405 X Super Raya	Better grain yield & disease resistance
BRJ-1304 X SP-223	Better grain yield and early maturity
BRJ-1501 X Super Raya	Better grain yield and drought resistance
BRJ-1519 X Khanpur raya	Better grain yield and more number of pods plant <sup>-1</sup>
BRJ-1458 X Bwp Raya	Better grain yield and more number of grains pod <sup>-1</sup>
BRJ-1452 X SP-235	Better grain yield and heat tolerance

### 3. Study of filial generations of *Brassica juncea*

Following progenies with desirable characteristics were selected for further evaluation.

Filial generations	No. of entries sown	Selected entries
F1	03	
F2	03	03
F3	18	12
F4	15	13
F5	10	07
F6	08	05

### 4. Preliminary mustard yield trial (A-trial)

Eight advanced strains of Mustard (Raya) were sown in preliminary yield trial. The trial was laid out according to RCBD with plot size of 6m<sup>2</sup>. Fertilizer @ 90-85-60 NPK kg/ha was applied. In addition to Rauni, 3 irrigations were applied throughout the growth period. The trial was sown on 19.10.2020 and harvested on 22.03.2021. BRJ-2051 (1811 kg/ha) and BRJ-2056 (1688 kg/ha) were the high yielder than check varieties i.e. Super Raya (1555 kg/ha) and Bahawalpur Raya (1561 kg/ha). Detail is given as under:-

Strains	Grain Yield (Kg/ha)	Strains	Grain Yield (Kg/ha)
BRJ-2051	1811	Super Raya (check)	1555
BRJ-2056	1688	BRJ-2058	1555
BRJ-2057	1677	BRJ-2055	1538
BRJ-2052	1628	BRJ-2054	1436
BWP Raya (check)	1561	BRJ-2053	1211
CV= 6.20		LSD (0.05)= 254.75	

### 5. Regular mustard yield trial (B-trial)



Five advanced strains (excluding checks) of Mustard (Raya) were tested under regular yield trial. The trial was laid out according to RCBD with plot size of 6m<sup>2</sup>. Fertilizer @ 90-85-60 kg NPK Kg/ha was applied. In addition to Rauni, 3 irrigations were applied throughout the growth period. The trial was sown on 19.10.2020 and harvested on 22.03.2021. BRJ-1997 (2036 kg/ha) and BRJ-1992 (1958 kg/ha) gave high yield than checks i.e. Super Raya (1644 kg/ha) and Bahawalpur Raya (1670 kg/ha). Detail is given as under:

Strains	Grain Yield (Kg/ha)	Strains	Grain Yield (Kg/ha)
BRJ-1997	2036	BRJ-1993	1725
BRJ-1992	1958	BWP Raya (check)	1670
BRJ-1995	1836	Super Raya (check)	1644
BRJ-1994	1795		
CV= 2.26		LSD (0.05)= 144.56	

#### 6. Advance mustard yield trial (C-trial)

Six advanced strains of Mustard (Raya) were tested under advance yield trial. The trial was laid out according to RCBD with plot size of 6m<sup>2</sup>. Fertilizer @ 90-85-60 NPK Kg/ha was applied. In addition to Rauni, 3 irrigations were applied throughout the growth period. The trial was sown on 19.10.2020 and harvested on 22.03.2021. BRJ-1102 (1977 kg/ha) and BRJ-1669 (1934 kg/ha) gave higher yield than Super Raya (1928 kg/ha) and Bahawalpur Raya (1925 kg/ha). Detail is given as under:-

Strains	Grain Yield (Kg/ha)	Strains	Grain Yield (Kg/ha)
BRJ-1102	1977	BRJ-1885	1927
BRJ-1669	1934	BWP Raya (check)	1925
BRJ-1882	1933	BRJ-1776	1616
Super Raya (check)	1928	BRJ-1886	1555
CV= 2.23	LSD (0.05)= 138.47		

#### 7. Micro yield trial of mustard (*Brassica juncea*)

Twelve strains of Mustard (Raya) were sown in micro yield trial. The trial was laid out according to RCBD with plot size of 6m<sup>2</sup>. Fertilizer @ 90-85-60 NPK Kg/ha was applied. In addition to Rauni, 3 irrigations were applied throughout the growth period. The trial was sown on 20.10.2020 and harvested on 24.03.2021. Entry No.02 gave maximum yield of 1984 kg/ha followed by entry No.12 with a yield of 1822 kg/ha. Detail is given as under:

S.No	Grain Yield (Kg/ha)	S.No	Grain Yield (Kg/ha)
1	1755	7	1661
2	1984	8	1595
3	1636	9	1333

4	1742	10	1623
5	1566	11	1301
6	1694	12	1822

#### 8. National uniform yield trial of mustard

Seed of 60 entries was supplied by the National Coordinator (Oilseed), NARC, Islamabad. Trial was sown under RCB layout with two replications with plot size of 6m<sup>2</sup>. The trial was sown on 20.10. 2020 and harvested on 24.03.2021. Data were recorded according to the instructions of National Coordinator (Oilseed). Entry No.22 gave maximum grain yield of 3150 kg/ha followed by Entry No.16 which gave grain yield of 3141 kg/ha. Results are given below:

Entry No.	Grain Yield (Kg/ha)	Entry No.	Grain Yield (Kg/ha)
1	2616	31	2516
2	3008	32	2150
3	2691	33	2550
4	2533	34	2491
5	1850	35	1733
6	3083	36	2325
7	2533	37	2441
8	1175	38	2050
9	1300	39	1675
10	2491	40	2598
11	2533	41	1658
12	2183	42	2433
13	1016	43	1908
14	2616	44	2025
15	850	45	1858
16	3141	46	2503
17	2533	47	2700
18	2283	48	1450
19	2558	49	1216
20	2133	50	2975
21	2766	51	2350
22	3150	52	1866
23	2100	53	2550
24	2525	54	2225
25	3016	55	2958
26	883	56	2241
27	2625	57	2600
28	1658	58	1341
29	2050	59	2516
30	2016	60	2483

#### 9. Production of pre-basic and “BNS” seed of Bahawalpur Raya

For production of BNS 10 to 12 single plants of BWP-Raya true to type were selected, single row of each selected plant was sown. 24 kg BNS Seed was collected for production of pre-basic seed of BWP-Raya. The following quantity of category seed of BWP-Raya was produced:

Category of seed	Seed Quantity (Kg)
BNS	24
Pre-basic	80
<b>Total</b>	<b>104</b>

## B. RAPESEED (*Brassica napus*)

### 1. Micro yield trial of rapeseed (*Brassica napus*)

Twelve strains of rapeseed were tested under micro yield trial. The trial was laid out according to RCBD with plot size of 6m<sup>2</sup>. Fertilizer @ 90-85-60 NPK kg/ha was applied. In addition to Rauni, 3 irrigations were applied throughout the growth period. The trial was sown on 20.10.2020 and harvested on 24.03.2021. Yield data of depicted that entry B gave maximum grain yield of 1462 kg/ha followed by entry A which yielded 1433 kg/ha. Detail is given as under:

S.No	Grain Yield (Kg/ha)	S.No	Grain Yield (Kg/ha)
A 1	1433	G 7	1106
B 2	1462	H 8	1105
C 3	1106	I 9	1177
D 4	1200	J 10	1066
E 5	1044	K 11	1177
F 6	1058	L 12	1295

### 2. National uniform yield trial of rapeseed

32 strains of Rapeseed were received from National Coordinator (Oilseed), NARC, Islamabad and were sown under RCBD layout in three replications with plot size of 6m<sup>2</sup>. Fertilizer @ 90-85-60 NPK kg/ha was applied. In addition to Rauni, 3 irrigations were applied throughout the growth period. The trial was sown on 20.10.2020 and harvested on 24.03.2021. Out of all strains, entry no.32 yielded maximum (2083 kg/ha) followed by entry no. 25 which gave grain yield of 1833 kg/ha. Data of seed yield are given as under:

Entry No.	Grain Yield (Kg/ha)	Entry No.	Grain Yield (Kg/ha)
1	1266	17	1141
2	1750	18	1475

3	966	19	1183
4	1300	20	1533
5	1283	21	1583
6	983	22	883
7	1500	23	833
8	1433	24	833
9	1500	25	1833
10	1000	26	1000
11	1116	27	1666
12	500	28	1750
13	1700	29	666
14	1475	30	833
15	1483	31	750
16	1250	32	2083

### C. TARAMIRA (*Eruca sativa*)

#### 1. Collection and maintenance of germplasm of taramera

Genepool of taramera was sown in the field of RARI, Bahawalpur. 50 accessions were received from the Director, Bio-Resource Conservation Institute, NARC, Islamabad, while 30 accessions were received from BARI, Chakwal. Sixteen better performing accessions were selected for preliminary yield trial of taramera during 2021-22.

#### a. Germplasm of taramera ( Director, bio-resource conservation institute, NARC, Islamabad)

S.No.	Accession No.	S.No.	Accession No.
1	1759	26	3667
2	1760	27	3668
3	3644	28	3669
4	3645	29	3671
5	3646	30	1672
6	3647	31	3673
7	3648	32	3674
8	3649	33	3675
9	3650	34	3678
10	3651	35	3679
11	3652	36	3680
12	3653	37	3681
13	3654	38	3682
14	3655	39	3683
15	3656	40	3684
16	3657	41	3685
17	3658	42	3686
18	3659	43	3696
19	3660	44	3697

20	3661	45	3698
21	3662	46	3700
22	3663	47	3701
23	3664	48	3702
24	3665	49	3703
25	3666	50	3704

**b. Germplasm of taranmera (BARI, Chakwal)**

S.No.	Accession No.	S.No.	Accession No.
1	CES00-3644	16	CES00-3659
2	CES00-3645	17	CES00-3660
3	CES00-3646	18	CES00-3661
4	CES00-3647	19	CES00-3662
5	CES00-3648	20	CES00-3663
6	CES00-3649	21	CES00-3664
7	CES00-3650	22	CES00-3665
8	CES00-3651	23	CES00-3666
9	CES00-3652	24	CES00-3667
10	CES00-3653	25	CES00-3668
11	CES00-3654	26	CES00-3669
12	CES00-3655	27	CES00-3670
13	CES00-3656	28	CES00-3671
14	CES00-3657	29	CES00-3672
15	CES00-3658	30	CES00-3673

**2. National uniform yield trial of taranmera**

Seed of nine strains supplied by the National Coordinator (Oilseed), NARC, Islamabad was sown under RCBD layout having three replications with plot size of 6m<sup>2</sup>. Entry No.3 gave maximum grain yield of 1166 kg/ha followed by Entry No.8 which gave grain yield of 1116 kg/ha. Data regarding seed yield are given as under:

S.No	Grain Yield (Kg/ha)	S.No	Grain Yield (Kg/ha)
1	1000	6	916
2	833	7	800
3	1166	8	1116
4	1166	9	833
5	833		

## PULSES SECTION

### A. MUNG [*Vigna radiata* L.]

#### 1. Collection and maintenance of germplasm

Mung germplasm consisting of 100 entries were sown following on 20.07.2020 keeping plot size of 2.4 m<sup>2</sup>. The entries were harvested on 10.10.2020. Observations regarding plant height (cm), days to 50% flowering, days to 90% pod maturity, 100-seed weight (g) and yield (kg/ha) were recorded and are presented as under:

Traits	Minimum	Maximum
Plant height (cm)	55	65
Days to 50% flowering	45	53
Days to 90% pod maturity	77	84
100-seed weight (g)	25	28
Yield (kg/ha)	729	1458



Fig:01 Bahawalpur mung 2017

#### 2. Hybridization

Four crosses were attempted during Kharif-2020 for further studies. None of the crosses was successful due to heavy rains. Detail of crosses is given as under:

1. CH-M-06 (early mature) × NM-11 (yellow mosaic virus resistant)
2. NM-11 (yellow mosaic virus resistant) × NIFA-M3 (bold seeded)
3. BRM-305 (high yielding) × AZRI-M-06 (heat resistant)
4. BRM-535 (drought resistant) × BRM-357 (high yielding)

#### 3. Preliminary yield trial

A trial of Mung bean consisting of 15 entries including two checks was conducted with 03 replications and a plot size of 4.8 m<sup>2</sup>. The trial was sown on 20.07.2020 and the recommended agronomic practices were followed throughout the growing season. The trial was harvested on 10.10.2020. The performance of strains is given as under:

Strains	Yield (kg/ha)	% ± Over checks	
		NM-2016	AZRI-M-18
BRM-102	1004	60.4	39.4
BRM-106	916	46.3	27.2
BRM-113	902	44.1	25.3
BRM-104	834	33.2	15.8
BRM-115	764	22.0	6.1
BRM-107	764	22.0	6.1

BRM-101	710	13.4	-1.4
BRM-111	710	13.4	-1.4
BRM-114	694	10.9	-3.6
BRM-110	690	10.2	-4.2
BRM-109	670	7.0	-6.9
BRM-103	655	4.6	-9.0
BRM-112	626	0.0	-13.1
NM-2016 (Check)	626		
AZRI-M-18 (check)	720		
CV=8.59%		LSD=68.02	

It is evident from the results that 06 strains out yielded both the checks.

#### 4. Advance yield trial

A trial of Mung bean consisting of 09 entries including 02 checks was conducted in RCBD fashion with 3 replications and a plot size of 4.8 m<sup>2</sup>. The trial was sown on 20.07.2020. The recommended agronomic practices were followed throughout the growing season. The trial was harvested on 27.10.2020. The performance of strains is given as under:

Strains	Yield (kg/ha)	% $\pm$ over checks	
		AZRI-M-18	NM-2016
BRM-411	1034	54.3	79.5
BRM-405	964	43.9	67.4
BRM-403	908	35.5	57.6
BRM-409	900	34.3	56.3
BRM-407	900	34.3	56.3
BRM-406	894	33.4	55.2
BRM-410	694	3.6	20.5
AZRI-M-18 (check)	576		
NM-16 (check)	670		
CV=11.59%		LSD=81.5	

Yield data in above table showed that all seven strains gave higher yield than both the checks.

#### 5. Adaptation yield trial

It consisted of 06 entries along with 02 checks and was conducted in RCBD design with 03 replications and a plot size of 4.8m<sup>2</sup>. The recommended agronomic practices were followed throughout the growing season. The trial was sown on 20-07-2020 and harvested on 29-10-2020. The performance of strains is given as under:

Strains	Yield (kg/ha)	% $\pm$ over checks	
		NM-2016	AZRI-M-18
BRM-385	1098	27.7	52.5
BRM-357	1094	27.2	51.9
BRM-392	980	14.0	36.1
BRM-396	824	-4.2	14.4
NM-16 (Check)	860		
AZRI-M-18 (Check)	720		
CV=9.9%		LSD=81.9	

Three strains gave higher yield than both checks while one strain was less in yield than the checks.

## 6. National uniform yield trial

A trial consisting of 15 entries was sown on 21.07.2020. It was laid out in RCBD with 3 replications and a plot size of 4.8 m<sup>2</sup>. Normal/recommended agronomic practices were applied as and when required. The trial was harvested on 20.10.2020 and yield data of trial were recorded. The compiled data were sent to National Coordinator Pulses (PARC), Islamabad while no entry out yielded the check variety Azri-Mung-2018 (1340 kg/ha).

Entry Name	Source	Yield (kg/ha)
AZRI-MONG 2018	Check	1340
E-08	AZRI,D.I.KHAN	1208
Inqlab Mung	Check	1190
15006	PRI,AARI,FSD	1184
BRM-392	RARI,BWP	1179
MSPS-119	PRP,NARC	1162
MPP-15023	Pulses Section, NIAB,FSD	1152
TM-1607	AZRI-BHAKAR	1130
MPP-15024	Pulses Section, NIAB,FSD	1130
MPP-15039	Pulses Section, NIAB,FSD	1125
MH-16054	Pulses Section, NIAB,FSD	1106
TM-1610	AZRI-BHAKAR	1090
MPP-16091	Pulses Section, NIAB,FSD	1080
TM-1611	AZRI-BHAKAR	1046
NCM-13	PRP,NARC	1034



## 7. Quality seed production

70 kg Pre-basic and 164 kg basic seed of BWP-MUNG-17 was produced during the year 2020.

### B. CHICKPEA (*Cicer arietinum* L.)

#### 1. Collection and maintenance of germplasm of chickpea

Chickpea germplasm consisting of 150 entries were sown on 22.10.2020 keeping plot size of 2.4 m<sup>2</sup>. The entries were kept under constant observation and similar agronomic practices were applied to all the entries. The entries were harvested on 28.04.2020. Observation regarding plant height (cm), days taken to 50% flowering, 90% pod maturity, 100-seed weight (g), pods plant<sup>-1</sup> and yield (kg/ha) were recorded and are presented as under:

Traits	Minimum	Maximum
Plant Height (cm)	60	75
Days to 50% flowering	75	85
Days to 90% maturity	128	140
100 seed weight (g)	25	28
Pods plant <sup>-1</sup>	55	70
Seed pod <sup>-1</sup>	01	02
Yield (kg/ha)	950	1952



Fig:02 Rohi Chana-2021

#### 2. Hybridization of chickpea

The following crosses were attempted during Rabi 2020-21.

S.No.	Name of Crosses			Successful crosses
		-		
1.	BRC-395	×	Noor-2013	Unsuccessful
2.	BRC-390	×	Noor-2013	Successful
3.	BRC-452	×	Bittal-16	Unsuccessful
4.	Bittal-16	×	BRC-474	Successful
5.	CH-51/99	×	Bhakkar-2011	Successful

Only 3 crosses (cross No. 2, 4 & 5) were successfully harvested for raising F<sub>1</sub> during next year.

#### 3. Chickpea preliminary yield trial

20 entries selected from local nursery and germplasm were evaluated including two checks (Bittal-16 and NIAB-CH104). These entries were sown in a plot size of 4.8m<sup>2</sup> on 22.10.2020. Normal/recommended agronomic practices were applied as and when required. The entries were kept under constant observation throughout the growth period. The trial was harvested on 14.04.2021. The performance is given as under:

Strains	Yield (kg/ha)	%± over check	
		BITTLE-16	NIAB-CH104
<b>BRC-601</b>	972	-12	22
<b>BRC-602</b>	1389	25	74
<b>BRC-603</b>	1181	6	48
<b>BRC-604</b>	1250	13	56
<b>BRC-605</b>	1111	0	39
<b>BRC-606</b>	729	-34	-9
<b>BRC-607</b>	833	-25	4
<b>BRC-608</b>	1354	22	69
<b>BRC-609</b>	833	-25	4
<b>BRC-610</b>	1528	38	91
<b>BRC-611</b>	694	-37	-13
<b>BRC-612</b>	1076	-3	35
<b>BRC-613</b>	729	-34	-9
<b>BRC-614</b>	833	-25	4
<b>BRC-615</b>	1181	6	48
<b>BRC-616</b>	833	-25	4
<b>BRC-617</b>	1319	19	65
<b>BRC-618</b>	1597	44	100
<b>BITTLE-16 (C)</b>	1110		
<b>NIAB-CH104 (C)</b>	799		
CV=12.38%		LSD= 127.8	

#### 4. Chickpea regular yield trial

A trial consisted of 10 entries including 02 checks (Bittle-16 and NIAB-CH104) was sown on 23.10.2020. It was laid out in RCBD with 3 replications and a plot size of 4.8m<sup>2</sup>. Normal/recommended agronomic practices were applied as and when required. The trial was harvested on 15.04.2021 and yield data of the entries was recorded and given in the following table:

Strains	Yield (kg/ha)	%± over check	
		Bittle-16	NIAB-CH104

<b>BRC-630</b>	1458	8	2.41
<b>BRC-631</b>	1424	5	-0.03
<b>BRC-632</b>	1424	5	-0.03
<b>BRC-633</b>	1319	-3	-7.34
<b>BRC-634</b>	1389	3	-2.47
<b>BRC-635</b>	1250	-8	-12.22
<b>BRC-636</b>	1806	33	26.79
<b>BRC-637</b>	1354	0	-4.90
<b>Bittle-16 (C)</b>	1354		
<b>NIAB-CH104 (C)</b>	1424		
CV=14.05%		LSD= 132.2	

Analysis of variance of the yield data revealed significant differences among mean values of various strains.

#### 5. Chickpea advance yield trial

A trial consisting of 10 entries including 02 checks (Bittle-16 and NIAB-CH104) was sown on 23.10.2020. It was laid out in RCBD with 3 replications and a plot size of 4.8m<sup>2</sup>. Normal/recommended agronomic practices were applied as and when required. The trial was harvested on 15.04.2021. The data are given in the following table:

Strains	Yield (kg/ha)	%± over check	
		BITTLE-16	NIAB-CH104
<b>BRC-513</b>	1458	17	0.2
<b>BRC-515</b>	1319	6	-9.3
<b>BRC-517</b>	1319	6	-9.3
<b>BRC-518</b>	1458	17	0.2
<b>BRC-520</b>	1667	33	14.5
<b>BRC-523</b>	1701	36	16.9
<b>BRC-526</b>	1285	3	-11.7
<b>BRC-527</b>	1493	19	2.6

<b>Bittle-16 (C)</b>	1250		
<b>NIAB-CH104 (C)</b>	1455		
CV=7.59%		LSD= 90.1	

Analysis of variance of the yield data revealed significant differences among mean values of various strains.

#### 6. Chickpea adaptation yield trial

A trial consisting of 08 entries including 02 checks (Bittle-16 and NIAB-CH104) was sown on 26.10.2020. It was laid out in RCBD with 3 replications and a plot size of 4.8m<sup>2</sup>. Normal/recommended agronomic practices were applied as and when required. The trial was harvested on 15.04.2021. The data are given in the following table:

Strains	Yield (kg/ha)	%± over check	
		BITTLE-16	NIAB-CH104
<b>BRC-526</b>	1181	-10	36
<b>BRC-517</b>	2083	58	140
<b>BRC-510</b>	1181	-10	36
<b>BRC-501</b>	1424	8	64
<b>BRC-474</b>	1840	39	112
<b>BRC-505</b>	1563	18	80
<b>Bittle-16 (C)</b>	1319		
<b>NIAB-CH104 (C)</b>	868		
CV=12.7%		LSD= 153.9	

Yield data showed that 04 entries out yielded both the check varieties. Analysis of variance showed highly significant differences among the genotypes.

#### 7. Chickpea micro yield trial (kabuli) Faisalabad.

A trial consisting of 12 entries was sown on 22.10.2020. It was laid out in RCBD with 3 replications and a plot size of 4.8m<sup>2</sup>. Normal/recommended agronomic practices were applied as and

when required. The trial was harvested on 16.04.2021 and yield data were recorded. The compiled data were sent to Chief Scientist, Pulses Research Institute, Faisalabad and results are as under:

Variety /Line	PRI,Fsd (N)	PRI, Fsd	PRI,Fsd (Irrigated )	K.Kot (Barani)	KallurKot (Irrigated)	Bhakkar (Barani)	Bhakkar	Chakwal	RARI BWP	Yield (Kg/ha)
<b>PCK-18004</b>	1390	1205	1599	1917	2042	339	938	1500	1424	<b>1373</b>
<b>PCK-18005</b>	1769	1322	1502	2458	2486	330	1083	1500	1493	<b>1549</b>
<b>PCK-18006</b>	1802	1463	1875	2611	2096	375	1042	1542	1493	<b>1589</b>
<b>PCK-18007</b>	1464	1199	1431	2191	2528	406	1500	1472	1250	<b>1493</b>
<b>PCK-18020</b>	1038	1180	1120	2604	1917	285	1313	1542	1354	<b>1372</b>
<b>PCK-18022</b>	1618	1439	1313	2455	2180	368	1500	1500	1493	<b>1541</b>
<b>TGK-1504</b>	958	1131	641	2437	2417	438	896	1458	1597	<b>1330</b>
<b>TGK-1508</b>	833	968	884	2347	2146	538	1229	1417	1771	<b>1348</b>
<b>PCK-18023</b>	1354	1050	1529	2298	2444	330	1667	1472	1535	<b>1520</b>
<b>PCK-18025</b>	1421	1169	1455	2257	2236	378	1250	1389	1354	<b>1434</b>
<b>PCK-18028</b>	1282	1407	1450	3118	2014	563	1410	1347	1458	<b>1561</b>
<b>Noor 2019</b>	1102	1315	1245	2753	1819	417	1361	1403	1701	<b>1457</b>

#### 8. Chickpea micro yield trial (desi) Faisalabad

A trial consisting of 16 entries was sown on 22.10.2020. It was laid out in RCBD with 3 replications and a plot size of 4.8 m<sup>2</sup>. Normal/recommended agronomic practices were applied as and when required. The trial was harvested on 16.04.2021 and yield data were recorded. The compiled data were sent to Chief Scientist, Pulses Research Institute, Faisalabad and results are as under.

Entry	PRI, Fsd	GBRSS, K.Kot	AZRI Bkr	RARI, B.Pur	K.Kot (Barani)	AZRI. Bkr(Barani)	Ave. (Kg/h)
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<b>D-18004</b>	4317	2583	1674	1389	2674	340	2163
<b>D-18007</b>	3876	2292	1479	1528	2104	396	1946
<b>D-18008</b>	2751	1896	1833	1285	2340	340	1741
<b>D-18009</b>	2284	2153	1410	1389	2042	281	1593
<b>D-18017</b>	2892	2049	1156	1563	2142	493	1716
<b>D-18020</b>	3097	2500	1597	1701	2035	344	1879
<b>D-18025</b>	3344	2708	1549	1111	2257	309	1880
<b>D-18026</b>	3354	2674	1563	1563	2500	271	1987
<b>D-18027</b>	3643	2465	1146	1354	2153	319	1847
<b>D-18032</b>	3569	2604	1910	1875	2479	424	2144
<b>D-18036</b>	3529	2465	1792	1389	2604	340	2020
<b>BRC-446</b>	<b>3449</b>	<b>2292</b>	<b>1688</b>	<b>1424</b>	<b>2788</b>	<b>469</b>	<b>2018</b>
<b>BRC-474</b>	<b>3923</b>	<b>2188</b>	<b>1292</b>	<b>1201</b>	<b>2403</b>	<b>453</b>	<b>1910</b>
<b>TG-1424</b>	3692	2104	1653	1146	2569	458	1937
<b>TG-1427</b>	3322	2778	1653	2014	2601	403	2128
<b>Bittal-2016</b>	<b>3504</b>	<b>2299</b>	<b>1618</b>	<b>1181</b>	<b>2771</b>	<b>448</b>	<b>1970</b>

### 9. Chickpea national uniform yield trial (desi) 2020-21

A trial consisting of 17 entries was sown on 02.11.2020. It was laid out in RCBD with 3 replications and a plot size of 4.8 m<sup>2</sup>. Normal/recommended agronomic practices were applied as and when required. The trial was harvested on 22.04.2021 and yield data of trial were recorded. This institute shared two strains named as BRC-474 and BRC-446. The compiled data were sent to National Coordinator Pulses (PARC), Islamabad and results are as under:

Strains	*Locations/yield (kg/ha)														MEAN
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
TG-1447	1873	790	1836	3735	1289	1125	3423	1417	3021	3958	814	820	1613	2123	<b>1988</b>
D-17006	2258	779	1924	3733	1029	1139	3174	2410	2847	2709	1351	837	1599	1717	<b>1965</b>
BRC-474	2057	893	1626	3918	1258	986	2841	2351	1803	3958	1260	818	1854	1737	<b>1954</b>
CH-26/13	2074	913	1813	4410	1044	1125	2799	1983	2782	2823	1035	822	1296	2086	<b>1929</b>
BRC-446	2009	678	1271	4176	1226	1111	2788	2375	2187	3056	1260	856	1556	1761	<b>1879</b>
D-17019	2084	655	1413	4416	1354	1063	3167	1563	2671	2569	1217	836	1313	1594	<b>1851</b>
D-17016	2090	1120	1776	3303	1303	1076	2993	2413	2708	2430	845	806	1366	1561	<b>1842</b>
CH-30/13	2073	771	1583	3412	1103	1070	2827	2443	2870	2674	1404	831	1151	1433	<b>1832</b>
D-16029	2749	789	1723	3454	1129	1104	3139	1823	2450	2257	1333	828	1186	1208	<b>1798</b>
TG-1621	2659	883	1299	3708	1166	1063	2799	2076	1619	2153	874	819	1990	1749	<b>1776</b>
D-17028	1854	913	1045	3597	989	1083	2903	2319	2523	2326	1334	857	1457	1612	<b>1772</b>

KK-66	2457	819	1487	2725	1094	1125	2556	2176	2022	2569	863	820	1265	1995	<b>1712</b>
D-17003	2600	892	1202	2468	1092	1083	2535	1545	2688	2674	1155	824	1331	1763	<b>1704</b>
TG-1626	1613	865	1625	2865	1039	1055	3021	1632	2147	2298	1306	838	1114	2341	<b>1697</b>
Indus-19	2171	707	1176	3158	949	1132	2875	1611	2399	2535	949	805	1185	1904	<b>1683</b>
KK-67	2043	945	1421	3023	1177	1049	2757	2184	1904	2188	794	821	1222	1681	<b>1658</b>
TG-1620	1638	1148	1695	2161	1400	1111	2351	1649	1983	1701	834	789	1337	1599	<b>1528</b>

Chickpea strain BRC-474 stood third by giving yield of 1954 kg/ha.

#### 10. Chickpea national uniform yield trial (kabuli) 2020-2021

A trial consisting of 15 entries was sown on 02.11.2020. It was laid out in RCBD with 3 replications and a plot size of 4.8 m<sup>2</sup>. Normal/recommended agronomic practices were applied as and when required. The trial was harvested on 22.04.2021 and yield data of trial were recorded. The compiled data were sent to National Coordinator Pulses (PARC), Islamabad and results are as under:

Strains	*Locations/ yield (kg/ha)												Mean
	1	2	3	4	5	6	7	8	9	10	11	12	
CK-69/09	1213	993	1599	1493	2132	2673	2219	1927	262	1449	1493	956	<b>1534</b>
CH-73/11	1468	959	1288	832	1859	2938	2231	1376	561	1476	1632	886	<b>1459</b>
K-17002	1410	1049	1920	1583	1710	2590	2115	1505	291	1439	764	1107	<b>1457</b>
CK-74/13	1428	979	1590	1365	1819	2521	2251	1253	377	1453	1354	1050	<b>1453</b>
K-15019	1366	1049	1493	1378	1812	2680	2051	1330	430	1454	1111	1063	<b>1435</b>
K-16027	1163	1028	1670	1292	1869	2785	2166	1376	289	1438	1075	869	<b>1418</b>
TGK-1504	1435	1028	1524	1358	1668	2320	2188	1172	396	1470	764	1626	<b>1412</b>
K-16010	1328	986	1580	1351	1546	2549	2094	1212	540	1453	972	1169	<b>1398</b>
Check (K)	1136	1007	1479	1260	1529	2327	1981	1394	506	1495	1222	1390	<b>1394</b>
TGK-1508	1402	986	1473	1304	1662	2521	2089	1047	560	1443	937	747	<b>1348</b>
K-17001	1337	1007	1691	632	1415	2458	2400	729	509	1413	1146	1367	<b>1342</b>
NCK-1902	1370	1035	1503	722	1476	2389	1676	915	591	1397	764	840	<b>1223</b>
KK-85	1282	972	1365	1015	1898	1972	843	983	391	1445	577	364	<b>1092</b>
15FCK-16	1222	1083	1386	594	1358	1833	1075	1048	482	1458	660	679	<b>1073</b>
NCK-1905	1357	1014	1646	257	1421	1587	977	435	187	1487	528	399	<b>941</b>

#### 11. Quality seed production

325 kg pre-basic seed of newly approved variety Rohi-Chana-21 (kabuli) was produced during the year 2020-21.

## MILLET SECTION

### A. SORGHUM (*Sorghum bicolor* L.)

#### 1. Collection and maintenance of germplasm

31 entries of sorghum were tested and maintained. Data regarding different traits i.e Plant height, days to heading and days to maturity were recorded and are given as under:

Traits	Ranges
Plant Height (cm)	145-325
Days to heading	81-94
Days to maturity	100-130

#### 2. Station yield trial of sorghum

10 promising lines of sorghum along with two checks (Jowar-86 and YSS-98) were tested for grain yield. The trial was sown under RCBD layout with three replications and plot size of 12m<sup>2</sup>. Fertilizer @ 125-115-0 NPK kg/ha was applied. Data regarding grain yield were recorded. The result showed that the strain RARI-S-14 performed well with high yield of 3416 kg/ha followed by RARI-S-17 which gave yield of 3014 kg/ha. Yield data of tested lines are given below:

Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)
RARI-S-14	3416	RARI-S-3	2750
RARI-S-17	3014	Jowar-86 (check)	2611
RARI-S-18	2986	RARI-S-5	2569
YSS-98 (check)	2958	RARI-S-16	2569
RARI-S-22	2847	BR-319	2333
CV %age= 14.92		LSD at 5% = 568.15	

#### 3. National uniform sorghum yield trial

16 promising strains/hybrids of sorghum along with two checks Sorghum-2011 and YS-16 were received from National Coordinator (Fodder), NARC, Islamabad. All the strains were tested for grain yield under RCBD layout with three replications and plot size of 12m<sup>2</sup>. Fertilizers @125-115-0 NPK kg/ha was applied. Data regarding grain yield were recorded and sent to National Coordinator (Fodder), NARC, Islamabad. The results showed that the SB-8690 performed well and gave maximum grain yield of 53.06 t/ha followed by entry F-1-2017 which gave yield of 51.62 t/ha and are presented in the following table:



Variety/ Hybrid	Yield (t/ha)							
	FRSS. Faisal abad	Sargh oda	Chak wal	Islam abad	Faisal abad	Sheik hupur a	Tando jam	Mean
F-1-2017	45.19	70.30	41.85	29.17	36.99	10.300	34.81	51.62
Sorghum-2011 (check)	51.11	58.83	28.89	32.87	37.71	69.11	37.04	45.08
B-203	43.33	62.53	44.15	30.56	38.79	81.96	34.81	48.02
SB-8690	44.82	66.23	43.70	41.67	50.13	91.52	33.33	53.06
F-03-2014	40.00	58.83	33.70	31.02	35.01	88.33	40.00	46.70
RARI-S-14	39.26	63.01	33.78	22.69	41.58	94.56	40.74	47.94
SGD-01-17	42.59	58.46	33.85	28.24	36.90	69.48	40.00	44.22
Sandal	42.96	62.90	26.59	30.09	32.94	77.22	38.52	44.46
YS-16 (check)	39.63	51.06	35.63	37.50	38.16	95.52	47.04	49.22
CV (%)	13.10	4.38	1.66	10.93	--	27.65	15.83	--
LSD (0.05)	9.80	4.65	1.03	5.97	--	40.99	10.55	--

## B. PEARL MILLET (*PENNISETUM AMERICANUM*)

### 1. Collection and maintenance of germplasm

28 entries of pearl Millet (Bajra) were tested and maintained. Data regarding different traits i.e Plant height, days to heading, days to maturity and other yield components were recorded and given as under:

Traits	Ranges
Plant Height (cm)	180-270
Days to heading	75-90
Days to maturity	100-110

### 2. Station yield trial of millet

10 promising strains of pearl millet (Bajra) along with two checks (Barani Bajra & Cholistani Bajra) were tested for grain yield. The trial was sown under RCBD layout having three replications with plot size of 12m<sup>2</sup>. Fertilizers @125-115-0 NPK kg/ha was applied. Data regarding grain yield were recorded. RARI-Composit-4 gave maximum yield of 2833 kg/ha followed by RARI-Composit-7 which gave yield of 2500 kg/ha. Yield data are presented in the following table:

Strains	Grain yield (kg/ha)	Strains	Grain yield (kg/ha)
RARI-Composit-4	2833	MS-1	1764
RARI-Composit-7	2500	RARI-Composit-1	1750
Cholistani Bajra (check)	2403	RARI-Composit-5	1722
Barani Bajra (check)	1875	RARI-Composit-6	1708
RARI-Composit-2	1792	RARI-Composit-3	1625
CV %age= 16		LSD at 5% = 568.35	

### 3. National uniform millet yield trial

31 promising hybrids of pearl millet along with two checks (YBS-98 and SGD-BAJRA-2011) were received from National Coordinator (Fodder), NARC, Islamabad. Entries were tested for grain yield under RCBD layout with three replications and plot size of 12m<sup>2</sup>. Fertilizers @ 125-115-0 NPK kg/ha was applied. Data regarding grain yield were recorded and sent to National Coordinator (Fodder), NARC, Islamabad. The results showed that the Tift-383 performed well and gave maximum yield of 48.28 t/ha followed by RARI-Composit-4 which gave yield of 47.86 ton ha<sup>-1</sup>. Yield data are presented in the following table:

Hybrid/ Variety	Yield (t/ha)							
	Islamabad	Faisalabad	Sheikhpura	Chakwal	Sarghoda	Faisalabad	Tandojam	Mean
RARI-Composit-4	59.26	40.44	59.41	41.48	42.96	64.82	26.66	47.86
YBS- 98 (check)	56.94	44.89	59.19	29.26	40.00	62.59	26.22	45.58
Tift-383	57.87	39.84	63.89	44.44	41.48	69.63	20.82	48.28
FB-803	52.78	39.33	58.33	29.26	40.89	58.89	21.94	42.92
FB-792	55.56	34.33	59.59	38.89	34.96	75.93	27.00	46.61
Tift-85D	61.11	32.56	67.96	35.93	37.63	58.15	21.38	44.96
FB-889	57.41	31.50	66.67	30.56	40.89	72.22	22.86	46.01
Sel-15	52.39	47.39	72.41	35.19	40.00	64.45	21.55	47.62
Sel-20	60.19	37.56	63.52	30.00	37.93	63.70	22.04	44.99
Sgd-Bajra-2011 (check)	64.67	48.61	78.59	33.33	43.56	74.08	23.91	52.39
CV (%)	13.43	--	16.01	4.80	9.81	8.38	16.73	--
LSD (0.05)	13.32	--	17.84	2.87	6.74	9.56	5.28	--

## VEGETABLE SECTION

Research Program of Vegetable Section, RARI Bahawalpur consisted of adaptability and yield trials of different vegetables for the Kharif and Rabi seasons and high quality seed production of selected vegetables during this year. A new crop Quinoa was also introduced in the section. This crop is of high economical value in the world. Moreover, it is considered as the best crop in the poor soils. Detail of experiments is given as under:

### 1. Characterization of quinoa germplasm (set-I)

Twenty two gene pool lines were collected from MNSUA, Multan and the strains were divided into two sets. Each strain was sown in two rows. Plot size of the trial was 5.0 x 0.75 meter. Trial was laid out accordance of augmented design. The trial was sown in November 2020 and harvested in April 2021. Five plants were selected out of the populations which were true to type. According to the data, strain **V-4** showed the best characters like plant height, number of branches and yield. Data are given below:

**Table – 01 Data of quinoa germplasm (set-I)**

Strain #	Plant Height (cm)	No. of Monopodial Branches	No. of Sympodial Branches	Seed Yield (gm.)	Seed Yield (kg/ha)
V-1	68	0	3	70.0	186.0
V-2	100	2	8	350.0	933.3
V-3	70	0	5	71.0	189.3
<b>V-4</b>	<b>101</b>	<b>2</b>	<b>10</b>	<b>400.0</b>	<b>1066.6</b>
V-5	90	0	7	200.0	533.3
V-6	88	0	4	250.0	666.6
V-7	58	0	2	50.0	133.3
V-8	85	1	4	170.0	453.3
V-9	79	1	3	77.0	205.3
V-10	91	2	7	118.0	314.6
V-11	96	0	6	192.0	512.0



Fig. 1 Quinoa strains (set-I)

### 2. Characterization of quinoa germplasm (set-II)

Twenty two gene pool lines were collected from MNSUA, Multan and the strains were divided into two sets. Each strain was sown in two rows. Plot size of the trial was 5.0 x 0.75 meter. Trial was laid out accordance of augmented design. The trial was sown in November 2020 and harvested in April-2021. Five plants were selected out of the population, which were true to type. According to the data, strain **V-19** showed the best characters like plant height, number of branches and yield. Data are given below:

**Table – 02 Data of quinoa germplasm (set- II)**

Strain #	Plant Height (cm)	No. of Monopodial Branches	No. of Sympodial Branches	Seed Yield (gm.)/Plot	Seed Yield (kg/ha)
V-12	110	2	3	350.0	933.3
V-13	101	1	2	300.0	800.0
V-14	88	0	1	90.0	240.0
V-15	97	0	2	100.0	266.6
V-16	100	2	3	300	800.0
V-17	111	4	6	412	1098.6
V-18	135	3	9	501.0	1336.0
<b>V-19</b>	<b>140</b>	<b>5</b>	<b>8</b>	<b>571.0</b>	<b>1522.6</b>
V-20	120	4	7	360.0	960.0
V-21	100	3	4	220.0	586.6
V-22	110	4	5	260.0	693.3



Fig. 2 Quinoa strains (set-II)

### 3. Zonal yield trial of radish

Four genotypes of Radish were collected from VRI Faisalabad. The Randomized Complete Block Design was applied with 3 replications. Plot size of the trial was 4.5 m<sup>2</sup>. Each strain had two rows. The data were collected in accordance with instructions by VRI, Faisalabad. The strain **ML-04** showed the best performance with average yield of **40,000 kg/ha**. Yield data are given as under:

**Table – 03 Yield data of ZYT of radish**

Strain #	Fruit Yield/ Plot (kg)	Fruit Yield (kg/ha)
ML – 01	16.0	35555.0
ML – 02	15.7	34800.0
ML – 03	15.0	33333.0
<b>ML – 04</b>	<b>18.0</b>	<b>40000.0</b>

#### 4. Zonal yield trial of turnip

Five genotypes of Turnip were collected from VRI, Faisalabad. The Randomized Complete Block Design (RCBD) was applied with 3 replications. Plot size of the trial was 4.5 m<sup>2</sup>. Each strain had two rows. The data were collected in accordance with instructions by VRI, Faisalabad. The strain **TR-05** showed the best performance with average yield of **44444 kg/ha**.

**Table – 04 Yield data of ZYT of turnip**

Strain#	Fruit Yield/ Plot (kg)	Fruit Yield (kg/ha)
TR – 01	19.0	42222.0
TR – 02	17.3	38511.0
TR – 03	18.3	40733.0
TR – 04	14.7	32577.0
<b>TR – 05</b>	<b>20.0</b>	<b>44444.0</b>

#### 5. Zonal yield trial of carrot

Three genotypes of **Carrot** were collected from VRI, Faisalabad. The Randomized Complete Block Design was applied with 3 replications. Plot size of the trial was 4.5 m<sup>2</sup>. Each strain had two rows. The data were collected in accordance with instructions by VRI, Faisalabad. The check variety **T-29** showed the best performance with yield of 144444 kg/ha.

**Table – 5 Yield data of ZYT of carrot**

Strain #	Fruit Yield/ Plot (kg)	Fruit Yield (kg/ha)
DL – 90	45.7	101466.0
DL – 03	46.7	103688.0
PROLINE	53.3	118511.0
<b>T-29</b>	<b>65.0</b>	<b>144444.0s</b>

#### 6. Zonal yield trial of spinach

Three genotypes of **Spinach** were collected from VRI, Faisalabad. The Randomized Complete Block Design was applied with 3 replications. Plot size of the trial was 4.5 m<sup>2</sup>. Each strain had two rows. The data were collected in accordance with instructions by VRI Faisalabad. The **S-01** showed the best performance with average yield of **34800 kg/ha**.

**Table - 6 Yield data of spinach**

Strain #	Fruit Yield/ Plot (kg)	Fruit Yield (kg/ha)
S – 01	19.0	42222.0
S – 02	10.3	22955.0

DESI	15.7	34800.0

## 7. Zonal yield trial of peas

Five genotypes of Peas were collected from VRI, Faisalabad. The Randomized Complete Block Design (RCBD) was applied with 3 replications. Plot size of the trial was 4.5 m<sup>2</sup>. Each strain had two rows. The crop was sown in October-2020 and harvested in February-2021. The data were collected in accordance with instructions by VRI, Faisalabad. The check variety **Meteor** showed the best performance with yield 2400 kg/ha.

**Table – 7 Yield data of ZYT of peas**

Strain #	Plant Height(cm)	No. of Pods/Plant	Pods Length (cm)	Seed Yield (gm.)	Seed Yield (kg/ha)
S – 9200 – 1	44.4	4.0	7.2	370.0	822.2
S – 9800 – 5 02	43.8	5.2	7.2	350.0	777.8
S – 2001 – 20	42.8	5.2	5.6	271.0	602.2
S – 9374	51.0	6.6	6.2	400.0	888.9
<b>Meteor</b>	<b>53.6</b>	<b>8.6</b>	<b>8.4</b>	<b>1200.0</b>	<b>2400.0</b>

## 8. Characterization of peas germplasm

NINE lines of Peas germplasm were collected VRI, Faisalabad. Each strain was sown in two rows. Plot size of the trial was 4.5 m<sup>2</sup> in accordance of augmented design. The trial was sown in November-2020 and harvested in April-2021. Five plants were selected out of the population, which are true to type. According to the data, strain **LINA PAK** showed the best yield performance along with the other characters like plant height, number of branches and yield. Data are given below:

**Table – 8 Data of peas germplasm**

Strain #	Plant Height (cm)	No. of Pods/Plant	Pods Length (cm)	Seed Yield (gm)/ plot	Seed Yield (kg/ha)
S – 9200 – 1	44.4	4.0	7.2	370.0	822.22
S – 9800 – 5	43.8	5.2	7.2	350.0	777.77
S – 2001 – 20	42.8	5.2	5.6	271.0	602.22
S – 9374	51.0	6.6	6.2	400.0	888.89
Meteor	53.6	8.6	8.4	1200.0	2400.00
S-2001-40	40.1	4.1	4.5	550.0	1222.23
S-2200-1	42.2	5.2	5.0	390.0	866.66
SUPREEM	50.0	6.6	5.9	901.0	2002.22
<b>LINA PAK</b>	<b>48.5</b>	<b>6.0</b>	<b>6.2</b>	<b>1002.0</b>	<b>2226.66</b>

## 9. Zonal yield trial of onion

Six genotypes of **Onion** were collected from VRI, Faisalabad. The Randomized Complete Block Design was applied with 3 replications. Plot size of the trial was 4.5 m<sup>2</sup>. Each strain had two rows. The data were

collected in accordance with instructions by VRI, Faisalabad. MIRPUR KHAS showing better yield 10066.66 kg/ha as compared to check PHULKRA.

**Table – 9 Yield data of ZYT of onion**

Strain #	Onion Yield (kg/Plot)	Onion Yield (kg/ha)
DESI RED	3.9	88577.77
Dark red	4.2	9244.44
Early red	4.1	9133.33
CR-10-5	4.4	9666.66
MIRPUR KHAS	4.5	10066.66
PHULKRA	4.3	9622.22

#### 10. Characterization of chilli germplasm

Six genotypes of **Chili** were collected from VRI, Faisalabad. The Randomized Complete Block Design was applied with 3 replications. Plot size of the trial was 4.5 m<sup>2</sup>. Each strain had two rows. The data were collected in accordance with instructions by VRI, Faisalabad. The strain V-1 was showed better number of fruit along with the better resistance against CLCV.

**Table – 10 Data of chili germplasm**

Strain #	CLCV %	Pt. Height Cm	No. of Monopodial. #	No. of Sympodial #	No. of Fruit/plant #
V-1	30.0	44.2	2.8	5.4	86.8
V-2	72.2	52.8	2.8	7.3	91.2
V-3	57.7	59.4	2.8	5.8	76.3
V-4	29.8	58.2	2.6	4.3	50.1
V-5	44.6	45.0	2.5	6.0	33.8
V-6	61.1	50.5	2.5	4.6	56.6

#### 11. Zonal yield trial of okra

Five genotypes of **Okra** were collected from VRI, Faisalabad. The Randomized Complete Block Design was applied with 3 replications. Plot size of the trial was 4.5 m<sup>2</sup>. Each strain had two rows. The crop was sown October-2020 and harvested in February-2021. The data were collected in accordance with instructions by VRI, Faisalabad. The check strain variety-V – 5 showed the best performance.

**Table – 11 Yield data of ZYT of okra**

Strain #	Plant Height (cm)	Fruit Length (cm)	Fruit Width (cm)	Fruit Yield (gm)/plot	Fruit Yield (kg/ha)
V – 1	60	10.0	7.0	475	1055.55
V – 2	65	13.0	7.5	230	511.11
V – 3	70	14.5	6.0	359	797.77
V – 4	80	10.0	7.0	1.088	2417.77
V – 5	100	15.0	8.0	1.350	3000.00

## 12. Hybridization program

The hybridization program was also conducted for the different vegetables like tomato, chilli, and peas. Number of crosses were attempted but due to the severe weather the crosses were not successful.

## 13. Seed production

Quality seed of selected vegetables (Kharif and Rabi) was produced to supply the seed public / private seed to companies and vegetable growers in the region. The quantity of produced seed of different vegetables is given below:

**Table -12 Seed production**

Crop	Varieties	Target (kg)	Achieved (kg)
Bottle gourd	FSD Goll	20	52
Carrot	T – 29	20	160
Radish	40 days	20	170
Turnip	Purple Top	20	22
Spinach	FSD SP	20	150

## AGRONOMY SECTION

### 1. Efficacy of weedicide and weed control practices in mung bean (*Vigna radiata* L.)

An experiment was conducted to evaluate the most effective weed control method in mungbean crop. The main objective was to evaluate the efficacy of different weedicides frequently used by farmers. The experiment was laid out in RCBD with four replications and a plot size of 10.8 m<sup>2</sup>. The trial was sown on 9.07.2020 under the following treatments.

Control, Hand weeding (once), Pendimethaline @3 lit ha<sup>-1</sup> (pre-emergence), Acetochlore @ 2 lit ha<sup>-1</sup> (pre-emergence), Pendimethaline @ 3 lit ha<sup>-1</sup> (Post-emergence), Acetochlore @ 2 lit ha<sup>-1</sup> (post-emergence), Quizlofop p-ethyl @ 500 ml ha<sup>-1</sup> (post-emergence). The pre-emergence treatments were applied to plots at the time of land preparation followed by sowing while post-emergence weedicides were applied after 1 month of sowing after the weed count. Harvesting and threshing was completed on 28.09.2020 and the yield data were recorded, analyzed and presented in the table 1:

**Table 1: Grain yield (kg/ha)**

Treatments	Grain yield (kg/ha)
Pendimethaline (Pre-Emergence)	819 A
Acetochlore (Pre-Emergence)	667 AB
Pendimethaline (Post-Emergence)	655 B



Acetochlore (Post-Emergence)	610 BC
Quizlofop P-ethyle (Post-Emergence)	908 A
Control	432 C
Hand Weeding	829 A
<u>LSD@0.05</u>	69

The results revealed that effective weed control in mungbean can be obtained by using Quizlofop-P-Ethyle and Pendimethaline (Pre-emergence), these weedicides are capable of controlling narrow and broad leaves of mungbean and could render higher grain yields. The maximum grain yield 908 kg/ha was recorded in Quizlofop P-ethyle and the weed mortality rate was 78%, however it was statistically at par to pendimethaline (pre-emergence) in which the weed mortality rate was recorded as 74%. While minimum grain yield (432 kg/ha) was obtained in Control. The average number of weeds before spray is presented in table 2. :

**Table 2: Weed count data**

Treatments	No. of weeds m <sup>-2</sup>	
	Broad leaved	Narrow leaved
T1	1	25
T2	2	9
T3	7	18
T4	9	35
T5	7	109
T6	3	170
T7	3	108

## **2. Genotype × environment interaction and stability of *sorghum bicolor* lines for some agronomic and yield traits in Southern Punjab**

The experiment was conducted to evaluate agronomic traits and stability of different sorghum genotypes. Three lines i.e. RARI-S-14, RARI-S-22 and Jowar-86 were tested under different environmental conditions (normal and saline soil). The experiment was laid out in split plot arrangement with three replications and a plot size of 24m<sup>2</sup>. The experiment was sown in normal and problematic soil at 10 days interval i.e. on 25 June and 5<sup>th</sup>, 15<sup>th</sup> and 25<sup>th</sup> July 2020. The data on grain yield were recorded at harvesting on 19.11.2020. The results obtained are presented in table 3.

**Table 3: Grain yield (kg/ha)**

Sowing date	Problematic Soil				Normal Soil			
	RARI-	RARI-S-	Jowar-	Mean	RARI-S-	RARI-S-	Jowar	Mean

	S-14	22	87		14	22	-86	
<b>D1</b>	1138	1014	968	1040 B	1560	1061	911	1177 B
<b>D2</b>	1419	1376	1194	1329 A	1806	1590	1393	1596 A
<b>D3</b>	1137	1084	1022	1081 B	1491	1338	1130	1319 A
<b>D4</b>	845	784	922	850 C	1153	852	1008	1004 B
<b>Mean</b>	1134 A	1064 B	1026 B		1502 A	1210 B	1110 C	

#### Problematic soil

LSD for sowing date= 226

LSD for varieties= 234

LSD for Soil condition= 371

#### Normal soil

LSD for sowing date= 266

LSD for varieties = 111

LSD for soil condition= 335

The Maximum grain yield was recorded in RARI-S-14 under both conditions i.e normal soil (1502 kg/ha) and problematic soils (1134 kg/ha) while under problematic soil conditions, the overall yield was less. As far as the sowing date is concerned, the crop sown on 05 July was the best under both soil conditions i.e. normal soil (1596 kg/ha) and problematic soil (1329 kg/ha).

### 3. Effect of row spacing on grain yield of newly developed millet (*pearl millet L.*) Strains

Two locally developed pearl millet strains (Composite-4 and Composite-7) were tested under three different row spacing (30, 45, 60 cm) to know their effect on the growth and final grain yield of millet crop. The experiment was laid out in split plot arrangement with three replications and a plot size of 24 m<sup>2</sup>. Trial was sown on 20.07. 2020. Grain yield data were recorded at harvesting on 20.11.2020.

The results revealed that grain yield of millet strains was significantly affected by various row spacing. The maximum yield of 1431 kg/ha was obtained at 45 cm apart row spacing. As far as the varieties are concerned, Composite-7 gave good results However, all the varieties are statistically at par. Grain yield data is given table 4.

**Table 4: Grain yield (kg/ha)**

Spacing/Grain yield (kg/ha)				
Varieties	30 cm	45cm	60cm	Means
Composite-7	1333	1431	1097	1287 A
Composite-4	1208	1056	1347	1204 A

Lsd for spacing @ 0.05=99Lsd for varieties @ 0.05 =98

### 4. Sowing date trial on raya (*Brassica juncea L.*)

The experiment was conducted to find out the most suitable planting time for the maximum production of locally developed six Raya strains. The experiment followed split plot arrangement with three replications and a plot size of 10.8m<sup>2</sup>. The sowing was done according to the scheduled sowing dates while the trial was harvested at maturity and data were recorded. Threshing was completed on 19.03.2021 and grain yield data were recorded that is presented in table 5.



Fig.01: Raya varieties under sowing date trials

**Table 5: Grain yield (kg/ha)**

Varieties	1 <sup>st</sup> October	15 <sup>th</sup> October	1 <sup>st</sup> November	15 <sup>th</sup> November	Means
BRJ-1304	1851	2530	1327.2	756	1616 A
BRJ-1405	1851	2685	1142.0	709	1597 A
BRJ-1458	1697	2654	1234.6	817	1601 A
BRJ-1775	1975	1944	1327.2	771	1504 B
BRJ-1778	1882	1821	1111.1	601	1354 C
Bwp- Raya	2129	2592	1327.2	663	1678 A
Super Raya	2129	2561	1265.4	679	1659.0 A
Means	1931 B	2399 A	1248 C	714 D	

LSD for sowing dates = 93  
LSD for Varieties = 120  
LSD for Interaction = 184

Three lines i.e. BRJ-1304, BRJ-1458 and BRJ-1405 gave maximum yields of 1616, 1601 and 1597 kg/ha, respectively. Bwp Raya gave maximum yield and was statically at par with the above mentioned lines. The least yield (1354 kg/ha) was obtained in case of BRJ-1778. As far as the sowing dates are concerned, second sowing date (15<sup>th</sup> Oct) resulted in the best yield (2399 kg/ha).

## 5. Adoption of newly developed wheat varieties/strains to climatic changes under Bahawalpur conditions

The experiment was conducted to evaluate the highly productive locally developed seven wheat strains and their adoption to the changing climate conditions of Bahawalpur. The trial was laid out in split plot arrangement with three replications and a plot size of 7.2 m<sup>2</sup>. Sowing of the trial was done according to the scheduled sowing dates. Wheat grain yield and experimental treatments are presented in table 6.

**Table 6: Grain yield (kg/ha)**

Wheat Grain Yield (kg/ha)									
	20 <sup>th</sup>	1 <sup>st</sup> Nov	11 <sup>th</sup>	21 <sup>st</sup>	1 <sup>st</sup>	11 <sup>th</sup>	21 <sup>st</sup>	1 <sup>st</sup> Jan	Mean

	Oct		Nov	Nov	Dec	Dec	Dec		
BF-1705	6482	6852	6019	6065	4260	3611	3657	2593	4942 A
BF-1807	5972	5370	5139	4861	3333	2870	2870	2269	4085 F
181601	5186	5880	6204	5093	3704	3287	2963	2778	4386 DE
BF-1902	5926	5602	5694	5116	3889	3241	2685	2315	4308 EF
BF-1910	4907	6343	6343	5139	4444	3241	3194	2593	4525 CDE
172190	6250	6343	6204	5000	3843	3565	3472	2685	4670 BC
Akbar-19	6713	6620	5880	5780	4444	3472	3333	3148	4936 AB
Ghazi-19	6157	6111	5926	5556	4167	3426	3287	2500	4641 CD
Mean	5950 A	6088 A	6005 A	5338 B	4010 C	3339 D	3182 D	2610 E	

LSD for varieties/strains@ 0.05 =271

LSD for sowing dates@0.05 =386

LSD for interaction @0.05 =813



Fig:02 Different wheat lines under sowing date trials

Sowing time is one of the most important factor which influences wheat yield. The reason behind this relies on the fact that by changing sowing date the climatic conditions like temperature, rainfall and humidity also fluctuate, ultimately affecting the plant's physiological functions. The results revealed that second sowing date i.e. 1<sup>st</sup> Nov was suitable for obtaining maximum grain yield. The best sowing date for wheat for Bahawalpur condition can be recommended as 1<sup>st</sup> of Nov as it gave maximum grain yield. Practice of sowing wheat after December should be banned. Maximum grain yield was obtained when the crop was sown on 1<sup>st</sup> Nov (6088 kg/ha). However, 11<sup>th</sup> Nov (6005 kg/ha) and 20<sup>th</sup> Oct (5950 kg/ha) sown crop was also statistically at par to 1<sup>st</sup> November. Wheat strain BF-1705 gave the highest mean grain

yield of 4942 kg/ha. Protein analysis was also conducted for all the varieties/ strains sown under all the scheduled sowing dates. Compiled data (protein %age) is given in table 7.

**Table 7: Wheat grain protein (% age)**

<b>Grain protein (%age) analysis report</b>								
Varieties/strains	20 <sup>th</sup> Oct	1 <sup>st</sup> Nov	11 <sup>th</sup> Nov	21 <sup>st</sup> Nov	1 <sup>st</sup> Dec	11 <sup>th</sup> Dec	21 <sup>st</sup> Dec	1 <sup>st</sup> Jan
BF-1705	14.4	13.6	13.4	13	13.5	13.8	14.1	16.2
BF-1807	13.7	14.1	13.8	13.7	13.8	14	14.1	14.9
181601	14.4	13.6	13.7	13.9	13.7	13.4	14.1	15.7
BF-1902	14.9	14.6	13.2	13.3	13.9	14.1	15.2	16.2
BF-1910	13.1	14.3	13.2	14.5	13.8	14.9	14.7	16
172190	14.2	13.9	13.7	13.4	14	13.3	14	14.1
Akbar-19	13.6	13.5	13.2	13.5	13.3	13.1	13.9	14.5
Ghazi-19	12.9	14.2	14.3	13.4	13.9	13.8	14.2	15.5

Source: Wheat Research Institute, AARI, Faisalabad

The protein analysis report revealed that grain protein percentage increased gradually with the delay in sowing dates. It means that late sown crop is better in grain protein as compared to early sown crop.

## 6. Response of wheat varieties under different moisture regimes in Southern Punjab

The experiment was conducted to evaluate the best possible moisture regime for various wheat varieties/strains under Bahawalpur conditions. The trial was laid out in RCBD split plot arrangement with three replications and a plot size of 12.6 m<sup>2</sup> and was sown on 20.11. 2020. The experimental treatments and irrigation levels are depicted in the table 8.

**Table:8 Treatments**

<b>Irrigations</b>	<b>Wheat Varieties</b>
I <sub>1</sub> = 1 irrigation at 25 days after sowing (DAS)	18003
I <sub>2</sub> = 3 irrigations at 25,80,115 days after sowing (DAS)	180059
I <sub>3</sub> = 5 irrigations at 25,50,75,100 and 125 days after sowing (DAS)	172190
	195715
	Ghazi-19

Trial was harvested on 15.04. 2021 and the wheat grain yield obtained under various irrigation treatments is presented in table 9

**Table 9: Wheat grain yield (kg/ha)**

Varieties	1 irri	3 irri	5 irri	Means
180003	4120	4954	4444	4506 A

<b>180059</b>	3426	4769	4583	4259 AB
<b>BF-1910</b>	3704	4398	4444	4182 B
<b>195715</b>	3472	4352	4537	4120 B
<b>Ghazi-19</b>	4074	4352	4491	4306 AB
<b>Means</b>	3759 B	4565 A	4500 A	

LSD for irrigation@0.05 =313

LSD for varieties@0.05 =297

LSD for interactions @0.05 =552

The results clearly depicted that different irrigations significantly affected the grain yield of wheat. Maximum grain yield was obtained when three irrigations were applied to wheat crop giving yield of 4565 kg/ha followed by five irrigations (4500 kg/ha ). The strain 180003 gave best yield results of 4506 kg/ha while minimum yield was obtained in case of 195715 (4120 kg/ha).

## 7. Response of seed rate on grain yield of wheat advanced lines

The experiment was laid out to evaluate the performance of different seed rates in wheat crop under Bahawalpur conditions. The experiment was laid out in RCBD arrangement with three replications and plot size of 12.6m<sup>2</sup>. The trial was sown on 20.11.2020 while the yield data were recorded at harvesting and threshing on 27.04.2021. The treatment details and results are given in the following table10:

**Table 10: Grain yield (kg/ha)**

Seed rate (Kg/ha)	BF-1705	BF-1807	Mean
75	4907	3935	4421 A
100	4167	3843	4005 B
125	4074	3533	3803 B
150	4028	3513	3770 B
Mean	4294 A	3706 B	

LSD for varieties @ 0.05=374

LSD for seed rate @ 0.05= 265

LSD for interaction @ 0.05= 625

The results revealed that maximum grain yield (4421 kg/ha) was obtained under 75 kg/ha seed rate. Moreover, all other treatments gave less grain yield and were statistically at par to each other.

## 8. Comparative study of wheat sowing methods under late sown conditions

The experiment was conducted to evaluate the efficacy of different sowing methods under late sown conditions. The methods included were Ridge sowing, Bed sowing with four lines, Bed sowing with three lines, Broadcast and Line sowing. The variety tested was Ghazi-19. The trial was sown on 12.12.2020. Harvesting was done on 19.04.2021 and grain yield data were recorded and presented in table 11.

**Table 11: Grain yield (kg/ha)**

<b>Treatment</b>	<b>Grain yield kg/ha</b>
Ridge sowing	4833 A
Bed sowing (four lines)	4333 AB
Bed sowing (three lines)	4200 ABC
Broadcast	3500 C
Line sowing	3667 BC

LSD value@0.05 = 669

The results showed that maximum yield of wheat crop (4833 kg/ha) was obtained under ridge sowing method under late sown conditions. Bed sowing with four lines also rendered good results (4333 kg/ha). While, broadcast method of sowing gave minimum yield of 3500 kg/ha. The yield obtained in case of line sowing was 3667 kg/ha.

#### **9. Determination of genetic coefficients of wheat varieties for crop modeling calibration.**

The experiment was conducted to evaluate the DSSAT crop growth model for determination of genetic coefficients of three prominent wheat varieties i.e. Johar-16, Aas-11 and Ghazi-19. The data regarding leaf area and biological yield were determined so far. The results revealed that maximum leaf area was gained till 11<sup>th</sup> of February which decreased with the increase in number of days. The leaf area index was found to be 3.21 at maximum growth. Finally the optimum grain yield (6250 kg/ha) was obtained from Johar-16 and second was Ghazi-19 with 6110 kg/ha. While, Aas-11 produced the minimum yield (5867 kg/ha). Final recommendation will be made after detailed analysis of soil profile and other all relevant data which is under process.

### **CHEMISTRY/SOIL SCIENCE SECTION**

#### **1. Response of mung bean to soil vs. foliar application to ferrous sulphate**

The experiment was conducted to evaluate the response of Mung bean cultivar “Bahawalpur Mung-17” to soil vs. foliar application of Ferrous Sulphate. The RCBD arrangement was followed with six treatments and three replications with a plot size of 22.5 m<sup>2</sup>. All soil application of fertilizer was applied at sowing on 09.07.2020 and foliar application was applied 40 DAS. All cultural practices and plant protection measures were adopted as per recommendations. Yield data were recorded at harvesting on 23.09.2020. Soil samples were collected before sowing and after harvest from the depths of 0-15 and 15-30 cm for

EC, pH, OM & NPK determination. The results showed that T<sub>4</sub> revealed maximum yield of 965 kg/ha which was statistically at par with T<sub>6</sub>, T<sub>5</sub>, T<sub>3</sub> and T<sub>1</sub>. So, results indicated that Ferrous Sulphate did not have any significant role and T<sub>1</sub> proved to be the best economical dose for this Mung bean cultivar.

**Table.1 response of soil vs foliar application of ferrous sulphate on mung bean cultivar “Bahawalpur mung-17”.**

Tr	Nutrients (kg/ha)				Yield (kg/ha)
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	FeSO <sub>4</sub>	
T <sub>1</sub>	23	34	25	0	702
T <sub>2</sub>	23	34	25	15	764
T <sub>3</sub>	23	34	25	30	883
T <sub>4</sub>	23	34	25	45	965
T <sub>5</sub>	23	34	25	0.5% <sup>(FA)</sup>	905
T <sub>6</sub>	23	34	25	1.0% <sup>(FA)</sup>	917
CV=7.5, LSD=268(0.05)					

FA=Foliar

application

## 2. Response of mung bean to soil vs foliar application to zinc sulphate

This trial was laid out in an RCBD arrangement with six treatments and three replications with a plot size of 22.5 m<sup>2</sup>. The objective of this study was to find out the effect of zinc sulphate on the yield of Mung bean. All soil application fertilizers were done at sowing on 09.07.2020 and foliar application was done at 40 DAS. All cultural practices and plant protection measures were adopted as per recommendations. Plant growth parameters were taken at different growth stages. The crop was harvested on 23.09.2020 and grain yield data were recorded. Soil samples were collected before sowing and after harvest from the depths of 0-15 and 15-30 cm for EC, pH, OM & NPK determination. The results revealed that T<sub>4</sub> gave maximum yield of 949 kg/ha which was statistically at par with all other treatments. So, results indicated that Zinc Sulphate did not have any significant role and T<sub>1</sub> proved to be the best economical dose for this Mung bean cultivar.

**Table.2: Effect of soil vs foliar application of zinc sulphate on mung bean cultivar “Bahawalpur Mung-17”**

Tr	Nutrients (kg/ha)				Yield (kg/ha)
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	ZnSO <sub>4</sub>	
T <sub>1</sub>	23	34	25	0	787
T <sub>2</sub>	23	34	25	15	890
T <sub>3</sub>	23	34	25	20	923
T <sub>4</sub>	23	34	25	25	949
T <sub>5</sub>	23	34	25	0.5% <sup>(FA)</sup>	859
T <sub>6</sub>	23	34	25	1.0% <sup>(FA)</sup>	894
CV=11.9, LSD=169 (0.05)					

FA=Foliar application

## 3. Response of mung bean to sulphur application



This experiment was conducted with the objective to find out the effect of different doses of sulfur on Mung bean yield. The trial was laid out in RCBD with seven treatments and three replications with a plot size of 22.5 m<sup>2</sup>. The sowing was completed on 09.07.2020 and all the N, P, K, and S were applied at sowing. All cultural practices and plant protection measures were adopted as per recommendations. Yield data were recorded at harvesting on 23.09.2020. Soil samples were collected before sowing and after harvest. The data collected revealed that the highest grain yield (918 kg/ha) was obtained in T<sub>4</sub> which was statistically at par with all other treatments. So, result showed that T<sub>1</sub> is the best economical dose for this Mung bean cultivar.

**Table.3: Effect of sulphur application on mung bean cultivar “Bahawalpur Mung-17”.**

Tr.	Nutrients (kg/ha)				Yield (kg/ha)
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	S & Ca	
T <sub>1</sub>	23	34	25	0	703
T <sub>2</sub>	23	34	25	15	811
T <sub>3</sub>	23	34	25	30	830
T <sub>4</sub>	23	34	25	45	918
T <sub>5</sub>	21	34	25	11	810
T <sub>6</sub>	20	34	25	22	824
T <sub>7</sub>	18	34	25	34	899
CV=11, LSD=217(0.05)					

#### 4. Impact of fertilizer doses on promising mung strains

The experiment was conducted with the objective to find out the impact of different NPK doses on Mung strains BRM-369 and 371 under Bahawalpur conditions. The seeds were soiled on 09.07.2020 in an Split Plot Design lay out with a plot size of 22.5m<sup>2</sup> having three replications and eleven different nutrient combinations/treatments. All N, P and K was applied at sowing according to treatments. Cultural practices and plant protection measures were adopted as per recommendation. Soil samples were collected before sowing and after harvest from the depths of 0-15 and 15-30 cm for EC, pH, OM & NPK determination. Yield data were recorded at harvesting on 23.09.2020. The data showed that highest yield of 1037 and 1031 kg/ha were obtained in T<sub>5</sub> that were statistically non-significant with all other treatments. Results indicated that T<sub>4</sub> is the best economical dose for both Mung strains.

**Table.4: Impact of fertilizer doses on promising mung strains BRM-369 and BRM-371.**

Tr.	Nutrients (kg/ha)			BRM-369 (kg/ha)	BRM-371 (kg/ha)
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O		
T <sub>1</sub>	0	0	0	277	269
T <sub>2</sub>	0	34	25	444	436
T <sub>3</sub>	12	34	25	684	676
T <sub>4</sub>	23	34	25	822	814
T <sub>5</sub>	36	34	25	1037	1031
T <sub>6</sub>	23	0	25	713	706

<b>T<sub>7</sub></b>	23	23	25	884	876
<b>T<sub>8</sub></b>	23	46	25	1031	1023
<b>T<sub>9</sub></b>	23	34	0	985	977
<b>T<sub>10</sub></b>	23	34	12	1000	1022
<b>T<sub>11</sub></b>	23	34	36	1035	1027
CV=9.29, LSD=138(0.05)					

## 5. Optimum fertilizer dose for millet crop

This study was conducted to find out the optimum dose of fertilizer for Millet cultivar Barani Bajra. Randomized Complete Block Design was followed with four treatments and three replications with a plot size of 22.5 m<sup>2</sup>. All P, K and 1/3<sup>rd</sup> N was applied at sowing on 03.07.2020, 1/3<sup>rd</sup> N with 1<sup>st</sup> irrigation and remaining 1/3<sup>rd</sup> N with 2<sup>nd</sup> irrigation were applied according to the treatments. Soil samples were collected before sowing and after harvest from the depths of 0-15 and 15-30 cm for EC, pH, OM & NPK determination. Cultural practices and plant protection measures were adopted as per recommendations. Yield data for all of the treatments were recorded at harvesting on 21.10.2020. Maximum yield of 5023 kg/ha was obtained in T<sub>4</sub> followed by a yield of 4754 kg/ha in T<sub>3</sub>, which are statistically at par. While T<sub>2</sub> and T<sub>1</sub> gave yields of 3244 and 2107 kg ha<sup>-1</sup>, respectively, which were significantly lower than the yields in T<sub>3</sub> and T<sub>4</sub>. So, T<sub>3</sub> (150-90-60 kg/ha) is recommended dose for this cultivar of Millet under Bahawalpur climate.

**Table 5: Optimum fertilizer dose for millet crop.**

<b>Tr.</b>	<b>Nutrients (kg/ha)</b>			<b>Yield (kg/ha)</b>
	<b>N</b>	<b>P<sub>2</sub>O<sub>5</sub></b>	<b>K<sub>2</sub>O</b>	
T <sub>1</sub>	0	0	0	2108 C
T <sub>2</sub>	75	45	30	3244 B
T <sub>3</sub>	150	90	60	4754 A
T <sub>4</sub>	225	135	90	5023 A
CV=5.7, LSD=430(0.05)				

## 6. Effect of zinc application on yield of millet crop

This experiment was conducted to find out the effect of zinc on yield of millet cultivar Barani Bajra. The experiment comprised of five treatments with three replications under RCBD layout with a plot size of 22.5 m<sup>2</sup>. Recommended dose of NPK (150-90-60 kg/ha) was applied in all the treatments except control (T<sub>1</sub>), where no fertilizer was applied. All P, K, Zn and 1/3<sup>rd</sup> N was applied at sowing on 03.07.2020, 1/3<sup>rd</sup> N with 1<sup>st</sup> irrigation and remaining 1/3<sup>rd</sup> N with 2<sup>nd</sup> irrigation according to the treatments. Zinc @ 0, 5, 10 and 15 kg/ha was applied in T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub>, respectively. Soil samples were collected before sowing and after harvest from the depths of 0-15 and 15-30 cm for EC, pH, OM & NPK determination. Cultural practices and plant protection measures were adopted as per recommendations. Yield data were recorded

at harvesting on 21.10.2020. Maximum yield of 4889 kg/ha was obtained in T<sub>5</sub>, where maximum dose of Zinc (15 kg/ha) was applied but this yield was statistically at par with the yields obtained in T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> whereas control (T<sub>1</sub>) gave significantly lower yield (2153 kg/ha) as compared to all other treatments. So, based on results obtained, T<sub>2</sub> (150-90-60-0 kg/ha) is the recommended dose for Barani Bajra under Bahawalpur climate.

**Table 6: Effect of zinc application on yield of millet crop.**

Tr.	Nutrients (kg/ha)				Yield (kg/ha)
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Zn	
T <sub>1</sub>	0	0	0	0	2153 B
T <sub>2</sub>	150	90	60	0	4620 A
T <sub>3</sub>	150	90	60	5	4635 A
T <sub>4</sub>	150	90	60	10	4859 A
<b>T<sub>5</sub></b>	<b>150</b>	<b>90</b>	<b>60</b>	<b>15</b>	<b>4889 A</b>
CV=6.1,					LSD=488(0.05)

#### 7. Optimum fertilizer dose for promising sorghum strain RARI-S-22 under Bahawalpur climate

The experiment was conducted to find out the optimum dose of fertilizer for Sorghum strain RARI-S-22. For this purpose, four treatments in three replications were laid out under RCBD arrangement with a plot size of 22.5 m<sup>2</sup>. All P, K and 1/3<sup>rd</sup> N was applied at sowing on 03.07.2020, 1/3<sup>rd</sup> N at 1<sup>st</sup> irrigation and remaining 1/3<sup>rd</sup> N at 2<sup>nd</sup> irrigation according to the treatments. Soil samples were collected before sowing and after harvest from the depths of 0-15 and 15-30 cm for EC, pH, OM & NPK determination. Cultural practices and plant protection measures were adopted as per recommendations. Yield data for all the treatments were recorded at harvesting on 26.11.2020. Maximum yield of 6503 kg/ha was obtained in T<sub>4</sub> followed by a yield of 6294 kg/ha in T<sub>3</sub> and these are statistically at par. While, T<sub>2</sub> and T<sub>1</sub> gave yields of 4515 and 3139 kg/ha, respectively, which were significantly lower than the yields in T<sub>3</sub> and T<sub>4</sub>. So, dose of fertilizer in T<sub>3</sub> (150-90-60 kg/ha) is recommended for this strain of sorghum under Bahawalpur climate.

**Table 7: Optimum fertilizer dose for sorghum strain RARI-S-22.**

Tr.	Nutrients (kg/ha)			Yield (kg/ha)
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	
T <sub>1</sub>	0	0	0	3139 C
T <sub>2</sub>	75	45	30	4515 B
T <sub>3</sub>	150	90	60	6294 A
<b>T<sub>4</sub></b>	<b>225</b>	<b>135</b>	<b>90</b>	<b>6503 A</b>
CV=5.9,				LSD=611(0.05)

#### 8. Effect of zinc application on yield of sorgum strain RARI-S-22 under Bahawalpur climate

This experiment was conducted to find out the effect of zinc on yield of Sorghum strain RARI-S-22. Five treatments with three replications were arranged under RCBD layout with a plot size of 22.5 m<sup>2</sup>. Recommended dose of NPK (150-90-60 kg/ha) was applied in all the treatments except control (T<sub>1</sub>), where no fertilizer was applied. All P, K, Zn and 1/3<sup>rd</sup> N was applied at sowing on 03.07.2020, 1/3<sup>rd</sup> N with 1<sup>st</sup> irrigation and remaining 1/3<sup>rd</sup> N with 2<sup>nd</sup> irrigation according to the treatments. Zinc @ 0, 5, 10 and 15 kg/ha was applied in T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub>, respectively. Soil samples were collected before sowing and after harvest from the depths of 0-15 and 15-30 cm for EC, pH, OM & NPK determination. Cultural practices and plant protection measures were adopted as per recommendations. Yield data for all the treatments were recorded at harvesting on 26.11.2020. Recorded data revealed that maximum yield of 4664 kg/ha was obtained in T<sub>5</sub>, where maximum dose of Zinc (15 kg/ha) was applied but this yield was statistically at par with the yields obtained in T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> whereas control (T<sub>1</sub>) gave significantly lower yield (2751 kg/ha) as compared to all other treatments. So, on the basis of results obtained, T<sub>2</sub> (150-90-60-0 kg/ha) is the recommended dose for Sorghum strain RARI-S-22 under Bahawalpur climate.

**Table 8: Effect of zinc application on yield of sorghum strain RARI-S-22.**

Tr.	Nutrients (kg/ha)				Yield (kg/ha)
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Zn	
T <sub>1</sub>	0	0	0	0	2751 B
T <sub>2</sub>	150	90	60	0	4291 A
T <sub>3</sub>	150	90	60	5	4321 A
T <sub>4</sub>	150	90	60	10	4560 A
T <sub>5</sub>	150	90	60	15	4664 A
CV=6.6, LSD=508(0.05)					

## 9. Screening of wheat strains against salinity (pot experiment) phase II

The study was conducted in pots, in continuation of the Hydroponic experiment to select the resistant wheat strains S<sub>1</sub>=180018, S<sub>2</sub>=180126 and S<sub>3</sub>=195715 against salinity which were selected as best performer in hydroponic solution culture experiment conducted during the previous year i.e. 2019-20. These wheat strains were sown in pots following complete randomized design in three replications and were subjected to four different salinity levels developed in 10 kg of soil per pot i.e. T<sub>1</sub>=2.5, T<sub>2</sub>=5, T<sub>3</sub>=10 and T<sub>4</sub>=15 dSm<sup>-1</sup> EC soil. The recommended dose of NPK (150-120-60 kg/ha) was applied in all the pots at sowing on 30.11.2020. Plants were harvested on 14.04.2021 at maturity stage. The data recorded revealed that wheat strain 180126 (S<sub>2</sub>) showed best results in four growth parameters i.e. grain yield, number of tillers, plant height, 1000-grain weight, while 180018 (S<sub>1</sub>) and 195715 (S<sub>3</sub>) showed good performance in only two parameters i.e. spike length and total biomass, respectively, at the highest salinity level i.e. 15 dSm<sup>-1</sup> as shown in table below. As we are more concerned about the performance of

these strains against high level of salinity, so it is obvious from the data collected that S<sub>2</sub>(180126) is the best salt tolerant strain in this comparative study.

**Table 9: Response of wheat strains at different levels of salinity (Pots)**

Strains		Plant height (cm)	No. of Tillers	Spike Length (cm)	Total Biomass (g Pot <sup>-1</sup> )	1000-GW (g Pot <sup>-1</sup> )	Grain Yield (g Pot <sup>-1</sup> )
<b>T<sub>1</sub>=2.5 dSm<sup>-1</sup></b>							
S <sub>1</sub>	180018	<b>61.8</b>	4.7	<b>10.4</b>	<b>8.2</b>	30.7	<b>3.4</b>
S <sub>2</sub>	180126	58.4	<b>5.3</b>	9.3	6.8	<b>32.9</b>	3.2
S <sub>3</sub>	195715	61.2	5.0	9.4	7.7	31.3	3.3
<b>T<sub>2</sub>= 5 dSm<sup>-1</sup></b>							
S <sub>1</sub>	180018	<b>58.6</b>	3.7	<b>10.3</b>	<b>7.9</b>	31.4	<b>3.6</b>
S <sub>2</sub>	180126	53.9	<b>4.7</b>	9.2	6.6	25.1	3.1
S <sub>3</sub>	195715	54.2	4.0	8.9	6.5	<b>33.6</b>	3.1
<b>T<sub>3</sub>= 10 dSm<sup>-1</sup></b>							
S <sub>1</sub>	180018	<b>54.0</b>	3.3	<b>10.2</b>	<b>6.9</b>	22.1	2.5
S <sub>2</sub>	180126	53.3	<b>4.0</b>	8.7	6.4	<b>24.7</b>	<b>3.0</b>
S <sub>3</sub>	195715	53.4	3.7	8.8	5.8	21.4	2.4
<b>T<sub>4</sub>= 15 dSm<sup>-1</sup></b>							
S <sub>1</sub>	180018	44.2	3.00	<b>8.28</b>	3.99	21.23	1.50
S <sub>2</sub>	<b>180126</b>	<b>44.7</b>	<b>3.67</b>	7.70	4.27	<b>21.67</b>	<b>1.74</b>
S <sub>3</sub>	195715	43.8	3.33	7.90	<b>4.29</b>	20.87	1.58

#### 10. Fertilizer requirement of promising wheat strains

The study was conducted to determine the most suitable dose of NPK for new wheat cultivars BF- 1705 & 172190. For this purpose, 11 treatments were used in three replications under split plot design with a plot size of 22.5 m<sup>2</sup>. All P, K & 1/3<sup>rd</sup> N, was applied at sowing on 12.11.2020 whereas the remaining 1/3<sup>rd</sup> N was applied at 1<sup>st</sup> irrigation and remaining 1/3<sup>rd</sup> N at 2<sup>nd</sup> irrigation according to the treatments. Yield data for all the treatments were recorded at harvesting on 14.04.2021. Soil samples were collected before sowing and after harvest from the depths of 0-15 and 15-30 cm for EC, pH, OM & NPK determination. According to results of experiment, fertilizer application increased grain yield of both strains. Maximum yield of 2699 and 2609 kg/ha was found in both strains in T<sub>8</sub> which is statistically at par with T<sub>4</sub>, T<sub>5</sub> & T<sub>11</sub>. So, T<sub>4</sub> proved to be the economical dose with a yield of 2624 and 2549 kg/ha, respectively. BF-1705 gave the more grain yield (2699 kg/ha) than that of 172190 (2609 kg/ha).

**Table.10: Impact of fertilizer on the yield of wheat strains.**

Tr.	Nutrients (kg/ha)			BF-1705 (kg/ha)	172190 (kg/ha)
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O		
T <sub>1</sub>	<b>0</b>	<b>0</b>	<b>0</b>	1129	1099
T <sub>2</sub>	0	120	60	1832	1712
T <sub>3</sub>	75	120	60	2116	2026

<b>T<sub>4</sub></b>	150	120	60	2624	2549
<b>T<sub>5</sub></b>	225	120	60	2669	2579
<b>T<sub>6</sub></b>	150	0	60	1951	1847
<b>T<sub>7</sub></b>	150	60	60	2041	1891
<b>T<sub>8</sub></b>	150	180	60	2699	2609
<b>T<sub>9</sub></b>	150	120	0	2086	1980
<b>T<sub>10</sub></b>	150	120	30	2280	2161
<b>T<sub>11</sub></b>	150	120	90	2684	2594
CV=10.62, LSD=375(0.05)					

## 11. Effect of integrated use of fertilizer and poultry manure on wheat yield

This experiment was conducted to find out the low-cost substitute of N-fertilizer. Five treatments were adopted for this study and these were replicated thrice under RCBD layout with a plot size of 44.6 m<sup>2</sup>. All P, K, Poultry manure (PM) and 1/3<sup>rd</sup> N was applied at sowing on 12.11.2020 while 1/3<sup>rd</sup> N at first irrigation and remaining 1/3<sup>rd</sup> N at milking stage, according to the treatments. Yield data for all the treatments were recorded at harvesting on 22.04.2021. Soil samples were collected before sowing and after harvest from the depths of 0-15 and 15-30 cm for EC, pH, OM & NPK determination. Cultural practices and plant protection measures were adopted as per recommendations. Maximum yield of 5128 kg/ha was obtained in T<sub>4</sub> followed by a yield of 5083 kg/ha in T<sub>2</sub>, 4993 kg/ha in T<sub>3</sub> and 4844 kg/ha in T<sub>5</sub>. In T<sub>5</sub>, only recommended dose of NPK was applied. The yields obtained in all treatments were statistically at par with each other except control which gave significantly lower yield (3289 kg/ha) as compared to all other treatments. So, PM @ 4 tons ha<sup>-1</sup> may be a good substitute of N-fertilizer under Bahawalpur climatic conditions.

**Table 11: Effect of integrated use of fertilizer and poultry manure on wheat**

Tr.	Nutrients (kg/ha)				Yield (kg/ha)
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	PM (ton ha <sup>-1</sup> )	
T1	0	0	0	0	3289 B
T2	0	120	60	4	<b>5083 A</b>
T3	75	120	60	2	4993 A
<b>T4</b>	<b>100</b>	<b>120</b>	<b>60</b>	<b>1</b>	<b>5128 A</b>
T5	150	120	60	0	4844 A
CV=9.5 LSD(0.05)=833					

## 12. Response of wheat to potash application at various stages

The experiment was designed to study the effect of Potash fertilizer application to wheat crop at various growth stages i.e. at sowing, 1<sup>st</sup> irrigation, 2<sup>nd</sup> irrigation and 3<sup>rd</sup> irrigation. Five treatments with three replications were arranged under RCBD layout with a plot size of 50.2 m<sup>2</sup>. All P & 1/3<sup>rd</sup> N was applied at

sowing on 12.11.2020 while  $1/3^{\text{rd}}$  N at first irrigation and remaining  $1/3^{\text{rd}}$  N at  $3^{\text{rd}}$  irrigation and K according to the treatments. Yield data for all the treatments were recorded at harvesting on 22.04.2021. Soil samples were collected before sowing and after harvest from the depths of 0-15 and 15-30 cm for EC, pH, OM & NPK determination. Cultural practices and plant protection measures were adopted as per recommendations. Data collected showed that maximum grain yield of 5183 kg/ha was obtained in T<sub>3</sub> followed by a yield of 5050 kg/ha in T<sub>4</sub>, 4983 kg/ha in T<sub>2</sub> and 4917 kg/ha in T<sub>5</sub>. The grain yields obtained in T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub> were statistically at par except in control (T<sub>1</sub>) where the yield obtained was 2923 kg/ha and it was significantly lower than all other treatments. Hence, it is obvious from the data that application of Potash fertilizer with 1st irrigation should be preferred under Bahawalpur climatic conditions.

**Table 12: Response of wheat to potash application at various stages of the crop.**

Tr.	Nutrients (kg/ha)				Yield (kg/ha)
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	K	
T1	0	0	0	-	2923 B
T2	150	120	60	At sowing	4983 A
<b>T3</b>	<b>150</b>	<b>120</b>	<b>60</b>	<b>At 1st irrigation</b>	<b>5183 A</b>
T4	150	120	60	At 2 <sup>nd</sup> irrigation	5050 A
T5	150	120	60	At 3 <sup>rd</sup> irrigation	4917 A
					CV= 9.4 LSD(0.05)=819

### 13. Response curve studies for new promising raya strains

This experiment was conducted to find a response curve of NPK for Raya crop. Newly evolved Raya strains BRJ-1304, BRJ-1405 and BRJ-1458 were tested with eleven combinations of NPK and three replications in a Split Plot Design with plot size of 49.5 m<sup>2</sup>. All P, K &  $1/3^{\text{rd}}$  N was applied at sowing on 23.10.2020 whereas the remaining  $1/3^{\text{rd}}$  N was applied at 1<sup>st</sup> irrigation and remaining  $1/3^{\text{rd}}$  N at 2<sup>nd</sup> irrigation according to the treatments. Cultural practices and plant protection measures were adopted as per recommendation. Soil samples were collected before sowing and after harvest from the depths of 0-15 and 15-30 cm for EC, pH, OM & NPK determination. Yield data were recorded at harvesting on 16.03.2021. The data revealed that all strains responded positively to fertilizer doses. Results showed that varieties differed significantly from one another in grain yield. Maximum yield was obtained from BRJ-1304 (1176 kg/ha) which was significantly higher as compared to other varieties BRJ-1405 and BRJ-1458. As far as the fertilizer dose is concerned, T<sub>8</sub> gave maximum yield among the strains i.e. BRJ-1304, BRJ-1405 and BRJ-1458. Moreover, it was found that the results of T<sub>8</sub> are statistically at par with T<sub>4</sub>, T<sub>5</sub> and T<sub>11</sub>. So, T<sub>4</sub> proved to be the economical dose for all three strains of Raya.

**Table.13: Effect of fertilizer treatments on Raya Strains**

Tr.	Nutrients (kg/ha)	BRJ-1304 (kg/ha)	BRJ-1405 (kg/ha)	BRJ-1458 (kg/ha)
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	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O			
T <sub>1</sub>	0	0	0	525	385	485
T <sub>2</sub>	0	60	60	804	611	711
T <sub>3</sub>	60	60	60	1056	864	963
T <sub>4</sub>	90	60	60	1136	943	1043
T <sub>5</sub>	120	60	60	1163	970	1070
T <sub>6</sub>	90	0	60	877	684	784
T <sub>7</sub>	90	30	60	970	777	877
T <sub>8</sub>	90	90	60	1176	983	1083
T <sub>9</sub>	90	60	0	957	764	864
T <sub>10</sub>	90	60	30	1076	890	983
T <sub>11</sub>	90	60	90	1169	977	1076
CV = 12.1, LSD = 112						

#### 14. Fertilizer requirement of promising desi chickpea strains

In this study, the effect of fertilizer application on Chickpea strains and the most suitable dose were investigated in field under the Bahawalpur conditions. New advance Chickpea strains BRC-446 and BRC-474 were tested with five combinations of NPK in a Split Plot Design with a plot size of 27 m<sup>2</sup>. All P, K and ½ N was applied at sowing on 13.11.2020 and remaining ½ N was applied at 1<sup>st</sup> Irrigation. Cultural practices and plant protection measures was adopted as per recommendations. Yield data for all the treatments were recorded at harvesting on 10.04.2021. Soil samples were collected before sowing and after harvest from the depths of 0-15 and 15-30 cm for EC, pH, OM & NPK determination. The statistical analysis showed that maximum yield of 1256 and 1121 kg/ha was obtained by the strains, respectively, under T<sub>5</sub> which was statistically at par with T<sub>2</sub> and T<sub>3</sub>. According to the results obtained, T<sub>3</sub> was found to be the economical dose for chickpea. However, the yield differences among varieties were statistically non-significant.

**Table.14: Impact of Fertilizer on the yield of Desi Chickpea Strains.**

Tr.	Nutrients (kg/ha)			BRC-446 (kg/ha)	BRC-474 (kg/ha)
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O		
T <sub>1</sub>	0	0	0	673	538



T <sub>2</sub>	30	60	0	987	852
T <sub>3</sub>	60	80	0	1121	987
T <sub>4</sub>	90	100	0	807	873
T <sub>5</sub>	60	80	60	1256	1121
CV=12.94,				LSD=211(0.05)	

### 15. Fertilizer requirement of promising kabuli chickpea strains

This experiment was conducted to find a response curve of Chickpea crop to different levels of NPK fertilizers applied. Newly evolved Chickpea strain BRC-408 was tested against five combinations of NPK in three replications following an RCBD lay out with a plot size of 22.5 m<sup>2</sup>. All P, K and ½ N was applied at sowing on 13.11.2020 and remaining ½ N was applied at 1<sup>st</sup> irrigation. Cultural practices and plant protection measures were adopted as per recommendations. Yield data for all the treatments were recorded at harvesting on 10.04.2021. Soil samples were collected before sowing and after harvest from the depths of 0-15 and 15-30 cm for EC, pH, OM & NPK determination. The statistical analysis showed that maximum yield of 1794 kg/ha was obtained in T<sub>5</sub> which was statistically at par with T<sub>2</sub> and T<sub>3</sub>. According to results obtained, T<sub>3</sub> was found to be the economical dose for chickpea.

**Table 15: Impact of Fertilizer on the yield of Kabuli Chickpea Strain**

Tr.	Nutrients (kg/ha)			Yield (kg/ha)
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	
T	0	0	0	1032
T <sub>2</sub>	30	60	0	1570
T <sub>3</sub>	60	80	0	1704
T <sub>4</sub>	90	100	0	1256
T <sub>5</sub>	60	80	60	1794
CV=12.42, LSD=344(				

### 16. Micronutrient requirement of wheat

This experiment was conducted to find out the micronutrient requirement of Wheat crop. For this purpose, wheat variety Ghazi-19 was subjected to six treatments. Experiment was laid out with three replications following RCBD layout with a plot size of 480 m<sup>2</sup>. All P, K, Zn, B, Fe, Mn & 1/3<sup>rd</sup> N, was applied at sowing on 12.11.2020 whereas the remaining 1/3<sup>rd</sup> N were applied at 1<sup>st</sup> irrigation and remaining 1/3<sup>rd</sup> N at 2<sup>nd</sup> irrigation according to the treatments. Yield data for all the treatments were recorded at harvesting on 14.04.2021. Soil samples were collected before sowing and after harvest from the depths of 0-15 and 15-30 cm for EC, pH, OM & NPK determination. Maximum yield of 3076 kg/ha was obtained in T<sub>6</sub> which was at par with T<sub>2</sub> and T<sub>3</sub> showing non-significant differences in yield. Minimum yield of 2890 kg/ha was observed where no micronutrient was applied i.e. Control. The data given in table below indicated that micronutrient and their combination had positive but non-significant

effect on grain yield. Hence, T<sub>1</sub> proved to be the economical dose for Ghazi-19 under Bahawalpur conditions.

**Table 16: Impact of micronutrients on wheat (Ghazi-19).**

Tr.	Nutrients (kg/ha)							Yield (kg/ha)
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Zn	B	Fe	Mn	
T <sub>1</sub>	150	120	60	0	0	0	0	2890
T <sub>2</sub>	150	120	60	5	0	0	0	2915
T <sub>3</sub>	150	120	60	0	1	0	0	2930
T <sub>4</sub>	150	120	60	0	0	20	0	3061
T <sub>5</sub>	150	120	60	0	0	0	10	2910
T <sub>6</sub>	150	120	60	5	1	20	10	3076
CV=12.2, LSD=419(0.05)								

## PLANT PATHOLOGY SECTION

### 1. Screening of wheat varieties/lines against leaf rust.

One hundred and ninety seven (197) wheat varieties/lines were sown in one row of 2m length with 30cm row to row spacing. The universal susceptible check for all three rusts (Morocco) was sown all around the trial to facilitate the natural inoculums spread.

The experiment was sown on 24.11.2020. All the test entries were inoculated by spraying fresh spore suspension of Leaf rust on leaves and injecting into tillers. Already rust infected plants collected from September-October sown spore trap nursery were transplanted between border rows in order to achieve rapid and continuous infection of rusts in the field.

Disease data were recorded by following the Modified Cobb's scale during the maximum disease appearance period and are presented in Table-1.

**Table-1: Results of leaf rust disease screening nursery (LRDSN)**

Sr. No.	Reaction	No. of entries	Name of promising varieties/lines
1	Disease free (0)	138	Blue silver, Durum-97, T.D-1, NARC-11, Pir-Sabak-05, Jauhar-16, Ghazi-19, Anaj-17, 2809, 180003, 180059 etc.
2	TR	06	Fareed-06, Zincol-16, 193870, 193896, 204081, 204114.
3	TS	04	193910, 204032, 204078, 204099.
4	R	02	Lasani-08, 193895.
5	MR	03	Iqbal-2000, Ujala-16, 193906
6	MRMS	20	Inqlab-91, Maxi-Pak-65, Benazir-13, Bakhtawar-02, Uqab-2000, Sahar-06, Chakwal-50, Mairaj-08, Gold-16, Punjab-11 Ufaq-02

			etc.
7	MS	04	BWP-2000, AAS-11, 204002, 204007.
8	MSS	14	Lu-26, Kohi Noor, BWP-97, A.S-02, Derawar-97, FSD-08 Galaxy-13 etc.
9	S	06	AARI-11, Millat-11, 204026 etc.
	<b>Total</b>	<b>197</b>	

According to the results, one hundred and thirty eight (138) were disease free, twelve (12) fell under TR, TS, R category, three (03) varieties/lines showed Moderately Resistant response, twenty varieties (20) fell into MRMS category while four (04) showed MS reaction and fourteen (14) varieties/lines fell into MSS categories. Six (6) varieties/lines showed susceptible response.



Fig. 1 Susceptible stage of leaf rust

## 2. Screening of wheat varieties/lines against yellow rust under inoculated conditions.

One hundred and ninety seven (197) wheat varieties/lines were sown in one row of 2 m length with 30 cm row to row spacing. The universal susceptible check for all three rusts (Morocco) was sown all around the trial. The check facilitated the spread of natural inoculum. The experiment was sown on 24.11.2021.

Test entries were inoculated by spraying fresh spore suspension of yellow rust on leaves and injecting into tillers. The diseased plants were transplanted between border rows to obtain rapid and continuous

infection in the field. Disease data were recorded following Modified Cobb's Scale on the appearance of disease and presented in Table 2.

**Table-2: Results of yellow rust disease screening nursery (YRDSN)**

S.No.	Reaction	No. of entries	Name of promising varieties/lines
1	Disease Free (0)	196	Blue silver, Inqlab-91, T.D-1, Ghazi-19, Jauhar-16, NARC-11, AARI-11, Fareed-06, Ufaq-02, Pir-Sabak-05 etc.
2	TR	01	Kohi Noor
3	TS	00	
4	R	00	
5	MR	00	
6	MRMS	00	
7	MS	00	
8	MSS	00	
9	S	00	
<b>Total</b>		<b>197</b>	

According to the results shown above, one hundred and ninety six (196) varieties/lines were disease free while only one (01) variety showed TR response. The reason of lower disease spread was that pathogen did not find suitable environment. The rainfall was very low i.e. about 15 mm. Fluctuation in temperature also suppressed the disease spread. The Pathogen did not find prolonged humid conditions which is necessary for disease to progress.



Fig. 2 Susceptible stage of yellow rust

### 3. Monitoring of leaf and yellow rusts incidence on varieties with known genes and virulence of isogonics lines in Southern Punjab.

Thirty two (32) wheat varieties/lines with known genes along with one hundred and fifteen (115) LR, eighty (81) YR and eighty five (85) SR isogenic lines were sown in 2 m long rows with 30 cm row to row spacing in single replication and one row of universal susceptible check of each three rusts (Morocco) was sown after every 5<sup>th</sup> test entry as well as around the whole trial. The trials were sown at five different locations of Southern Punjab. The sowing was done during different dates of the month of November 2020.

Observations on the disease incidence were recorded at the time of disease appearance as under (Table-3).

**Table-3: Results of different isogonics lines/differentials**

#### A. LEAF RUST (LR) ISOGENIC LINES

S. No.	Pedigree / Origin / Lr	Varieties/lines	Disease response
1		Triticale	10MR
2		Morocco	80 S
3	Syria	Cham 4	20 MRMS
4	Syria	Cham 6	5 MR
5	Syria	Cham 8	60 S
6	Syria	Cham 10	5 MSS
7	Algeria	Hidhab	30 MSS
8	Morocco	Aguilal	10 MRMS
9	Morocco	Arrehane	10 MRMS
10	Syria	Salamoni	5 R

11	West Asia	Roomy	5 MSS
12	North Africa	FloranceAourour	40 S
13	North Africa	Potam	5 MRMS
14	North Africa	Nesma	80 S
15		Serie 87	40 MSS
16		PBW 343	0
17		Bohouth 6	20 MRMS
18		Bohouth 8	10 MRMS
19		Babaqa	60 S
20		MaxiPak	60 S
21	ICW09-0004-OAP-oBr-2AP-OTS-OAP	Cham 4/CA8055	40 S
22	Syria	Morocco	5 R
23	Syria	Cham 1	20 MRMS
24	Syria	Cham 3	0
25		Cham 5	0
26		Saframaan	0
27	Algeria	OuedZenati	0
28	North Africa	SenatoriCapelli	0
29	Tunisia	Chili	0
30	Tunisia	Karim	0
31	ICD95-1302-C-3AP-0AP-1AP-0AP-5AP-AP-5AP-0AP	Geruftel-1	0
32	ICD95-0169-C-0AP-2AP-0AP-4AP-0AP	Tunsyer-2	0
33	ICD95-1174-C-3AP-0AP-9AP-0AP	Geromtel-1	0
34	ICD95-0169-C-0AP-3AP-0AP-5AP-0AP	Icasyer-1	0
35		Sebou	0
36		Belikh-2	0
37		Atlas-1	0
38		Ammar-3	0
39		ICA Rasha-1	0
40		Aghram	0
41		Bohouth 9	0
42		Bohouth 11	0
43	ICD91-0811-AB-3AP-0AP-5AP-0AP	Otb-06	5 R
44		Morocco	20 MRMS
45	Lr22b	Thatchex	80 S
46	Lr1	RL6003	60 MSS
47	Lr2a	RL 6016	0
48	Lr2b	RL6019	60 MSS
49	Lr2c	RL6047	80 S
50	Lr3	RL6002	80 S
51	Lr3Ka	RL6007	40 MRMS

52	Lr3Bg	RL6042	60 S
53	Lr9	RL6010	80 S
54	Lr10	RL6004	60 S
55	Lr11	W976	60 MSS
56	Lr12	RL6011	80 S
57	Lr13	Manituou	80 S
58	Lr14a	RL6013	60 MSS
59	Lr14b	RL6006	60 S
60	Lr15	RL6052	80S
61	Lr16	RL6005	80S
62	Lr17	RL6008	40 MRMS
63	Lr18	RL6009	20 MRMS
64	Lr19	RL6040	80 S
65	Lr20	W203	80 S
66	Lr21	RL6043	80 S
67	Lr22a	RL6064	60S
68	Lr23	RL6012	20 MRMS
69	Lr24	Agent (RL6064)	80 MSS
70	Lr25	Transec (Awned)	30S
71	Lr26	RL6078	80 MSS
72	Lr10,Lr27+Lr31	Gatchar (w3201)	80 MSS
73	Lr28	CS2D-2M	80 S
74	Lr29	RL6080	80 S
75	Lr30	RL6049	80 MSS
76	Lr32	RL5497	20 MRMS
77	Lr33	RL6057	80 MRMS
78	Lr34	RL6058	20 MSS
79	Lr35	R711	40 MSS
80	Lr36	E84018	80 S
81	Lr37	RL6081	80 S
82	Lr B	RL6051	80 S
83	Lr13	WL711	60 MSS

### SUMMARY OF RESULTS

S.No.	Reaction	No. of entries	Name of promising varieties/lines
1	Disease Free (0)	62	Cham-4, Cham-6, Cham-8, Cham-10, Hidhab, Aguila, Salamoni, Roomy, Potamm , Nesma, Triticale etc
2	TR	00	00
3	TS	00	00
4	R	03	Manitouo, RL-6043, RL-6057.
5	MR	01	RL-6049
6	MRMS	08	Cham-1, RL-6047, RL-6011, RL-6005, RL-6040 RL-6078, W3201, RL-5497 etc.

7	MS	01	RL-6013
8	MSS	06	Mexi Pak, RL-6016, RL-6052, Transec, RL-5711, E-84018 etc.
9	S	02	RL-6006, RL-6081 etc.
Total		83	

## B. YELLOW RUST (YR) ISOGENIC LINES

S. No.	Pedigree / Origin / Lr	Varieties/lines	Disease response
1		Triticale	0
2	F	Morocco	0
3	Yr1	YR 1/6Avocetes	0
4	NIL 1	YR 1/6Avs	0
5	(W;Yr1)	Chinese 166 (WYR-1)	0
6	Yr1	Chinese 166	0
7	Yr2	Kalyansona	0
8	(W;Yr2+?)	Heines VII	0
9	(W;Yr3a,4a+other)	Vilmorin23	0
10		Morocco	0
11	(W;Yr4)	Hybrid46	0
12	Yr5	YR 5/6Avs	0
13	Yr5	Triticumspelta	0
14	Yr6	YR 6/6Avocetes	0
15	(S; Yr6+1)	Heineskolben	0
16	(S; Yr6+?)	Heinespeko	0
17	Yr6, Yr20	Fielder	0
18	Yr7	YR 7/6Avs	0
19	(S;Yr7)	Lee	0
20		Morocco	0
21	(W;Yr7+?)	Reichersberg42	0
22	Yr7	Thatcher	0
23	Yr8	YR 8/6Avs	0
24	(S;Yr8)	Compare	0
25	Yr9	YR 9/6Avs	0
26	Yr9	Fed.4/Kavkaz	0
27	(W;Yr9+Yr2+?)	Clement	0
28		Federation	0
29	Yr10	YR 10/6Avs	0
30		Morocco	0
31	(W; Yr10)	Moro	0
32	Yr15	YR 15/6Avs	0
33	Yr17	YR 17/6Avs	0
34	(W;2-more?)	StrubesDickopf	0
35	(W)	Suwon92xomax	0
36	(W;YrND)	Nord Desprez	0
37	Yr32	YR 32/6Avs	0



38	(W,Yr32)	Carstens V	0
39	YrSP	YR SP/6Avs	0
40		Morocco	0
41	(W;YrSP)	Spaldings Prolific	0
42	YrA	Avocetes R	0
43	YrA	Inia 66	0
44		Aocetes S	0
45		Tres/6Avs	0
46	Yr18	YR 18/3Avs	0
47	Yr18+	Jupateco R	0
48		Jupateco S	0
49	YrA,Yr18	Anza	0
50		Morocco	0
51	APR	Cook	0
52	Yr21	Lemhi	0
53		TP981	0
54	Yr25	TP1295	0
55	Yr27	YR 27/6Avs	0
56	Yr27	Ciano 79	0
57	Yr27+?	ATT II A CM85836-50Y	0
58	Yr27+Yr18	Opata 85	0
59	Yr28	Avocet-YRA 3/3 Altar	0
60		Morocco	0
61	Yr29	LalBahadurpavan	0
62	Yr31	AVOCET-YRA 3/PASTOR	0
63	Yr31+APR	PASTOR	0
64		Pollmer.2.1.1	0
65	DW	Cham 1	0
66		Cham 4	0
67		Cham 6	0
68		Cham 8	0
69		Gobustan	0
70		Morocco	0
71		Sardari	0
72		Alamout	0
73		Bohouth 6	0
74		Gereck 79	0
75		Hugenoot	0
76		Gun91	0
77		Dustlik	0
78		TATARA CM85836- 50Y	0
79		Suwon 92/omar	0
80		Morocco	0
81		Triticale	0

## SUMMARY OF RESULTS

S.No.	Reaction	No. of entries	Name of promising varieties/lines
1	Disease Free (0)	81	Triticale, Morocco,Chinese-166, Cham-1, Cham-4, Cham-6, Cham-8, Sardari, Gun-91, Alamout, Gereck-79 etc
2	TR	00	00
3	TS	00	00
4	R	00	00
5	MR	00	00
6	MRMS	00	00
7	MS	00	00
8	MSS	00	00
9	S	00	00
Total		81	

### C. STEM RUST (SR) SR ISOGENIC LINES

S. No.	Pedigree / Origin / Lr	Varieties/lines	Disease response
1			0
2	Thatcher/Chinese Spring	ISr5-Ra CI 14159	0
3	Red Egyptian/Chinese Spring	ISr6-Ra CI 14163	0
4		Na 101/6*Marquis	0
5	Hope/Chinese Spring	ISr7b-Ra CI 14165	0
6	Red Egyptian/CS (CI 14167)	CI 14167/9*LMPG-6 DK04	0
7		Barleta Benvenuto (CI 14196)	0
8	Red Egyptian/Chinese Spring	ISr9a-Ra CI 14169	0
9	Kenya 117A	Prelude*4/2/Marquis*6/Kenya 117A	0
10	Hope/Chinese Spring	ISr9d-Ra CI 14177	0
11	Little Club //3* Gabo /2* Charter /3/3* Steinwedel	Vernstein PI 442914	0

	/ CI 7778		
12	Selection from Kubanka (CI 1516)	Chinese Spring*7/Marquis 2B	0
13	Marquis*4/Egypt NA95/2/2*W2691	W2691Sr10 CI 17388	0
14	Lee (CI 12488)	Lee/6*LMPG-6 DK37	0
15		Chinese Spring*5/Thatcher 3B	0
16		Prelude*4/2/Marquis*6/Khapstein	0
17		W2691*2/Khapstein	0
18		Prelude*2/Norka	0
19		Thatcher/CS (CI 14173)	0
20			0
21	Esp 518/9	Prelude/8*Marquis*2/2/Esp 518/9	0
22		Little Club/Sr18Mq Marquis "A"	0
23		94A 236-1 Marquis "B"	0
24		94A 237-1 Marquis "C"	0
25	VA 2001 Increase	McNair 701	0
26	Einkorn CI 2433	<i>T. monococcum</i> /8*LMPG-6 DK13	0
27		Mq*6//Stewart*3/RL 5244	0
28		Exchange CI 12635	0
29	Little Club/Agent (CI 13523)	LcSr24Ag	0
30		Agatha (CI 14048)/9*LMPG-6 <b>DK16</b>	0
31		Eagle Sr26 McIntosh	0
32		WRT 238-5 (1984) Roelfs	0
33		Kota RL471	0
34		Prelude/8*Marquis/2/Etiole de Choisy	0
35	Webster CI 3780	Selection from Webster F3:F4 #6	0
36	Benno (Sr31)	Sr31 (Benno)/6*LMPG-6 DK42	
37		ER5155 S-203 (1995)Roelfs	0
38		RL 5405 (1192) Kerber	0
39		RL 6098 (1997) Dyck	0
40			0
41		RL 6099 (1995) Dyck	0
42	CI 12632 <i>T. timopheevii</i>	W2691SrTt-1 CI 17385	0
43		Prelude*4/Line W (W3563)	0
44	08 Aberdeen Inc. Source Z. Pretorius	Trident Sr38	0
45	07GH	Trident	0
46		RL 5711 Kerber	0
47		RL 6087 Dyck	0
48	Hard red winter	TAM 107	0
49	Hard red winter	Amigo	0
50	Hard red winter	Siouxland	0
51	Hard red winter	Roughrider	0

52	Soft red winter	Sisson	0
53	Soft red winter	Fleming	0
54		Chris	0
55	08 Aberdeen Inc. Source: 06 AB YJ	CsSSrTmp	0
56		Bt/Wld	0
57		Pavon 76	0
58		Einkorn	0
59		Seri 82	0
60		<b>Morocco</b>	0
61		PBW343 = Attila with Sr31	0
62		Kubsa = Attila	0
63	Iran	Chamran = Attila	0
64	Syria	Cham 6	0
65		Cham 8	0
66	Syria	Cham 10 = Kauz//Kauz/star	0
67		Bacanora = Kauz's'	0
68		Cook	0
69		Coorong ( Triticale)	0
70		Satu	0
71		SrNin	0
72		Karim	0
73		Imillo	0
74		Altar	0
75	Sudan	EL Nielain	0
76	Algeria	Hidhab	0
77	Egypt	Gemmeiza 9	0
78	Egypt	Giza-168	0
79	Morocco	Arrehane	0
80		<b>Morocco</b>	0
81	Sudan	Debeira	0
82	Morocco	Aguilal	0
83		Thatcher	0
84		Guard	0
85		<b>Triticale</b>	0

In case

of Leaf Rust, most of the lines showed disease free response which includes Punjab-97, Pasban-90, M.H-97, **BWP-50**, Derawar-2000, Chakwal-50, **A.S-2006**, **Manthar-2006**, Fareed-06, Shafaq-06 and Sahar-06. While some of them showed moderately susceptible as well as susceptible response like Faisal-85, Rohtas-90, Ufaq-2003, Cham-10, Hidhab, Roomy, and Serie-82. In case of Yellow Rust, most of the lines except one or two fell into disease free category like Triticale, Morocco, Chinese-166, Cham-1, Cham-4, Cham-6, Cham-8, Sardari, Gun-91, Alamout and Gereck-79. No stem rust was observed on any entry as well as on check.

**4. Screening of wheat varieties/lines against stem rust (*Puccinia graminis*) under natural field conditions.**

One hundred and ninety one (191) wheat varieties /lines were sown in single row of 1m length with 30cm row to row spacing. One parallel line of local susceptible check for stem rust (Faisalabad-08) alongside of test entries was sown for equal distribution of disease for each entry strictly under natural condition. While universal susceptible check for all three rusts (Morocco) was sown all around the trial. Both checks facilitated the natural inoculum spread. The sowing was done on 24.11.2020. Stem rust did not appear on any entry during the whole crop period.

**5. genetic resistance in wheat germplasm against leaf blotch (*Bipolaris sorokiniana*) of wheat under natural field condition.**

One hundred and ninety seven (197) wheat varieties/lines were sown in one row of 2 m length with 30 cm row to row spacing. One parallel line of susceptible check for spot blotch (Bhakhar-02) was sown after every five entries and in between the repeats as spreader for leaf blotch. The check facilitated the natural inoculum spread. The experiment was sown on 24.11.2020. Disease data were recorded at the time of disease appearance and are given in Table 4.

**Table-4: Results of spot blotch disease screening nursery (SBDSN)**

S. No.	Reaction	No. of entries	Name of promising varieties/lines
1	0	185	Blue silver, Inqlab-91, Lu-26, Kohi-noor, Maxi-pak-65, Lasani-08, Mairaj-08, Fareed-06, Ujala-16, Gold-16, Ghazi-19, etc.
2	R	12	Bakhtawar-02, Durum-97, 180015, 204054, 204065 etc.
3	MR	03	Darawar-97, 193870, 193959.
5	MS	00	00
6	S	00	00
<b>Total</b>		<b>197</b>	

One hundred and eighty five (185) entries out of 197 test entries were disease free while twelve (12) entries showed resistant reaction, similarly Three (03) entries showed moderately resistant response. No one showed moderately susceptible, susceptible and highly susceptible response towards leaf blotch disease due to less humidity during this year.



Fig. 3 Severe attack of leaf blotch

#### 6. Survey for determination of karnal bunt in wheat seed lots grown in Southern Punjab.

Eighty two (82) wheat seed samples were collected during 2021 harvest season from different seed lots at farmer's field, these samples were examined for Karnal bunt spores on the basis of soaking method i.e. Wheat seed samples were soaked in 0.2% NaOH solution for 24 h at 20°C. Disease data were recorded by calculating the Coefficient Infection (CI) of infected seeds. Observations of disease incidence were recorded on healthy and bunted grains basis by following disease rating scale of **Aujla *et al.* (1989)**.

Out of eighty two (82) samples, forty eight (48) were found to be highly resistant and seven (07) were found to be resistant towards disease, while twenty seven (27) were infected from Karnal bunt disease, the results are given in Table 5.

**Table-5: Results of farmers seed lots samples for karnal bunt disease.**

CI (coefficient of infection)	Category	No.of Samples	Coefficient infection of seven Infected samples
0	Highly Resistant (1R)	48	0
0.1-5	Resistant (2R)	07	0.025, 0.05, 0.75 etc
5.1-10	Mod. Susceptible(1S)	27	0
10.1-20	Susceptible (2S)	0	0
20.1 and Above	Highly Susceptible(3S)	0	0
<b>Total</b>		<b>82</b>	

**7. Screening of wheat varieties/lines against karnal bunt (*Neovossia indica*) under inoculated condition.**

Eighty six (86) different wheat varieties/lines received from ? were sown in single row of 1 m length with 30 cm row to row. After every 2 test entries one row was kept fallow to facilitate the inoculation pressure. The experiment was sown on 11.11.2020. Observations of the disease incidence were recorded at the time of maturity on healthy and bunted grains basis are given in Table 6.

**Table-6: Results of karnal bunt disease screening nursery (KBDSN)**

CI (coefficient of infection)	Category	Varieties/Lines	Promising Cultivars/Lines
0	Highly Resistant (1R)	58	Sahar-06, Mairaj-08, Lasani-08, Millat-11, Punjab-11, NARC-11, Johar-16, Ujala-16 and Ghazi-19 etc.
0.1-5	Resistant (2R)	17	Fareed-06, Shafaq-06, Kohinoor, FSD-08, TD-1 and WL-711 etc.
5.1-10	Moderately Susceptible(1S)	04	AAS-11, 204004 etc.
10.1-20	Susceptible (2S)	03	AARI-11, 180003 and 204012.
20.1 and Above	Highly Susceptible(3S)	04	Gold-16, 204008, 204014 and 204029.
<b>Total</b>		<b>86</b>	

Results showed that 58 well-known commercial varieties/lines fell into highly resistant (HR) category. About seventeen (17) varieties/lines showed R response towards karnal bunt. Similarly, four (4), three (3) & four (4) varieties/lines fell into MS, S and HS categories, respectively.



Fig. 4 Karnal bunt affected seeds

## 8. Screening of wheat varieties/lines against loose smut (*Ustilago tritici*) of wheat.

Two hundred and sixty (260) previous year inoculated varieties/lines were sown on 24.11.2020 for loose smut disease screening. The sowing was done in two meter long single rows with 30 cm row to row spacing in single replication. The test entries were inoculated with fresh spore suspension of loose smut at the time of earing. The data of disease incidence were recorded at the time of maturity, on diseased and healthy tiller basis are given in Table-7.

**Table-7: Results of loose smut disease screening nursery (LSDSN)**

Category	Rating	No. of var./lines	Promising varieties/lines
Disease free	0	43	Fareed-06, FSD-08, Millat-11, 12B-2511, 13B-2809, 180022, 193819, 193826, 193827, 193828 etc.
Resistant (R)	1% or less	60	Punjad-I, Chakwal-50, Gold-16, 17B-554, 180003, 17, 180005, 180018, 180033, 180043, 180050 etc
Moderately Resistant (MR)	1-10%	134	Blue silver, Lu-26, Maxi-Pak-65, Benazir-13, Pak-81, BWP-97, Bakhar-2002, Uqab-2000, Sehar-06, Shafaq-06, Durum-97, WL-711, A.S-2002 etc.
Moderately Susceptible (MS)	11-20%	14	Derawar-97, NARC-11, Ghazi-19, 12B-2567, 193821, 193823, 193824, 193833, 193845 etc
Susceptible (S)	21-50%	03	Inqlab-91, 193842, 193870 etc
Highly Susceptible (HS)	>51%	00	00
<b>Total</b>	<b>254</b>		

Out of 254 varieties/lines, forty three (43) varieties/lines were disease free while sixty (60) varieties/lines showed resistant response, one hundred and thirty nine (134) were Moderately resistant, fourteen (14) having Moderately susceptible reaction while Three (03) varieties/lines showed susceptible (S) response towards loose smut.





Fig. 5 Loose smut affected spike

**9. Screening of mustard germplasm against alternaria blight ( *Alternaria brassicae*) white rust (*Albugo candida*) and powdery mildew (*Erysiphe polygoni*).**

Disease data of Brassica cultivars/lines sown by oil seed section were taken. Data of disease intensity on mustard plants were recorded on the basis of disease rating scale 0-5, which was developed by Meah *et al.* (1994) given below in the Table-9.

**Table 9: Data of alternaria blight, white rust and powdery mildew**

**1. Alternaria blight**

Scale	Reaction	Disease Severity %	No. of Entries	Name of Entries
0	Disease free (I)	0	0	
1	HR	0.1-6%	0	
2	R	6.1-12%	04	E3, E12, E14, E16
3	MR	12.1-25%	24	E1, E2, E4, E5, E6, E10, E11, E13, E15, E17, E18 etc.
4	MS	25.1-50%	07	E7, E8, E9, E24, E33, E34, E35
5	S	50.1 % & above	00	
Total			35	

Among thirty five (35) test entries, four (04) entries showed resistant response, twenty four (24) entries showed moderately resistant, seven (07) entries showed moderately susceptible response towards Alternaria Blight. No one was Immune or highly resistant against Alternaria Blight.



Fig. 6 Severe attack of Alternaria blight

## 2. White rust

Scale	Reaction	Disease Severity %	No. of Entries	Name of Entries
0	Disease free (I)	0	00	
1	HR	0.1-6%	11	E3, E5, E7, E12, E14, E15, E16, E19, E20, E24, E31
2	R	6.1-12%	18	E4, E6, E8, E9, E10, E11, E13 etc.
3	MR	12.1-25%	06	E2, E23, E27, E33, E34, E35
4	MS	25.1-50%	00	00
5	S	50.1 %&above	00	00
Total	35			

In case of white rust, among all 35 entries eleven (11) entries showed highly resistance response towards white rust while eighteen (18) entries were showed resistance response similarly six (06) entries showed moderately resistant response towards disease. No one showed moderately susceptible, susceptible and highly susceptible response toward white rust.



Fig. 7 Severe attack of white rust

### 3. Powdery mildew

Scale	Reaction	Disease Severity %	No. of Entries	Name of Entries
0	Disease free (I)	0	00	00
1	HR	0.1-6%	09	E3, E11, E12, E14, E15, E20, E28, E30, E35
2	R	6.1-12%	21	E1, E2, E5, E6, E7, E8, E9, E10 etc.
3	MR	12.1-25%	05	E4, E13, E18, E25, E33
4	MS	25.1-50%	00	00
5	S	50.1 %&above	00	00
Total			35	

In case of Powdery Mildew among all 35 entries, Nine (09) varieties were showed highly resistance response towards Powdery Mildew, twenty one (21) entries showed resistant response while five (05) entries showed moderately susceptible response towards Powdery mildew. No one showed moderately susceptible, susceptible and highly susceptible response toward Powdery Mildew.





Fig. 8 Severe attack of powdery mildew

**10. Surveillance of wheat rusts in Southern Punjab (incidence and severity of wheat diseases).**

The main objective for the rust monitoring and surveillance activity was to record the status of prevailing rust infection in farmer field and varietal resistance/susceptibility status. Surveillance of wheat rust pathogens includes assessment of rust incidence. It provides basic information that helps in formulating and adopting appropriate policies, investments and strategies in plant protection, plant breeding, seed systems and in rust pathogen research. Surveillance of wheat rusts was carried out in major districts of Southern Punjab.

The representative sites to be visited and probable dates were decided and a route plan was developed that mentioned the priority areas to be visited for the surveillance activities.

At each site 3-5 representative sites were decided to visit, the data were recorded regarding GPRS location, name of cultivar, disease incidence and intensity were recorded. Sampling of the diseased plant was done following the specific route according to plan. Observations were taken after every 15 to 20 kilometer.

Total 174 sites were visited and detail of 119 sites given below in Table 10. Fifty five sites were excluded due to less kilometer covered, GPRS do not showing any difference.

**Table-10: Detail of surveillance activities for the year 2020-21.**

S.No	Date	GPRS Location	Place visited	Stem Rust	Stripe Rust	Leaf Rust	Severity Percent	Variety
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1.	<b>17/02/21</b>	29.18830 071.37032	Khanpur Mirchanwala	Nil	Nil	Nil	-	Mixture
2.	Do	29.15502 071.30568	Ahmad Pur	Nil	Nil	Nil	-	Unknown
3.	Do	29.11919 071.19485	Noor wali	Nil	Nil	Nil	-	Akbar-19
4.	Do	29.112600 071.18664	Ratuwali	Nil	Nil	Nil	-	Unknown
5.	Do	29.13163 071.02458	Channi Goth	Nil	Nil	Nil	-	Zincole
6.	Do	29.05072 070.97890	MulanWali	Nil	Nil	Nil	-	Bhakar-02
7.	Do	29.03536 071.97372	LiaqatPur	Nil	Nil	Nil	-	Unknown
8.	Do	28.969740 070.95322	Liaqatpur	Nil	Nil	Nil	-	Unknown

9.	Do	28.94972 070.77875	Ameen Abad	Nil	Nil	Nil	-	Unknown
10.	Do	28.98504 071.58532	Khan bella	Nil	Nil	Nil	-	FSD-08
11.	<b>18-02-21</b>	101M 29.53981 072.54759	Lodhran	Nil	Nil	Nil	-	Bhakar Star
12.	Do	98M 29.54317 071.31869	Ada Bahmni	Nil	Nil	Nil	-	Jauhar-16
13.	Do	146M 29.85286 072.93169	MauzaKanhooon, Jalal Pur	Nil	Nil	Nil	-	Unknown
14.	Do	101M 29.48402 071.23484	Guja Moor, jalalPur	Nil	Nil	Nil	-	Mixture
15.	Do	99M 29.37093 071.17629	Jhangra	Nil	Nil	Nil	-	Galaxy-13
16.	Do	100M 29.26662 071.03843	UchSharief	Nil	Nil	Nil	-	Unknown
17.	Do	93M 29.35376 071.01505	Head Punjnad	Nil	Nil	Nil	-	Unknown
18.	Do	93M 29.46830 070.94139	Parmit, Alipur	Nil	Nil	Nil	-	Ghazi-19
19.	Do	85M 29.46193 070.79059	Jatoi	Nil	Nil	Nil	-	Unknown
20.	Do	101M 29.38406 070.74541	Basti Meerani, Khairpur Sadat	Nil	Nil	Nil	-	Akbar-19
21.	<b>18-02-21</b>	105M 29.33326 071.64661	11 BC Bahawalpur	Nil	Nil	Nil	-	Ghazi-19
22.	Do	108M 29.26918 071.68828	14BC Bahawalpur	Nil	Nil	Nil	-	Unknown
23.	Do	102M 29.07042 071.75296	Mukdi Adda, Yaman	Nil	Nil	Nil	-	Unknown
24.	Do	102M 28.96902 071.97839	Cholistan	Nil	Nil	Nil	-	FSD-08
25.	Do	99M 28.97114 071.53164	Mithra Bangla	Nil	Nil	Nil	-	Galaxy-13

26.	Do	90M 28.94032 071.41551	Chak 124	Nil	Nil	Nil	-	Unknown
27.	Do	106M 28.93780 071.34873	Deep Cholistan	Nil	Nil	Nil	-	Mixture
28.	Do	130M 28.99160 071.30114	BastiMeerani	Nil	Nil	Nil	-	Mixture
29.	Do	68M 29.10602 071.44940	CheemaChowk, Head Rajgan	Nil	Nil	Nil	-	Unknown
30.	Do	87M 29.21927 71.55542	Khanqah Sharif	Nil	Nil	Nil	-	Unknown
31.	<b>25-02-21</b>	62M 29.52756 070.65258	Lodhran	Nil	Nil	Nil	-	Unknown
32.	Do	62M 29.58959 071.78260	Dhanoot	Nil	Nil	Nil	-	Akbar-19
33.	Do	92M 29.67390 070.94828	KehrorPacca	Nil	Nil	Nil	-	Unknown
34.	Do	142M 29.72707 072.05460	MeeranPur, Mailsi	Nil	Nil	Nil	-	Unknown
35.	Do	127M 29.83931 072.11600	Mailsi	Nil	Nil	Nil	-	Unknown
36.	Do	123M 29.96013 071.91833	Tiba Sultan Pur	Nil	Nil	Nil	-	Unknown
37.	Do	119M 20.25202 071.09331	Khanewal	Nil	Nil	Nil	-	Unknown
38.	Do	120M 29.17133 071.86473	Jangle Mariala	Nil	Nil	Nil	-	Unknown
39.	Do	124M 29.91786 071.781341	QutubPur	Nil	Nil	Nil	-	Unknown
40.	Do	109M 29.74222 071.72053	DunyaPur	Nil	Nil	Nil	-	Unknown
41.	Do	128M 29.92919 071.51464	Ada Bakht Ali, Multan	Nil	Nil	Nil	-	Unknown

42.	Do	118M 30.07769 071.35920	Shair Shah Pul, Multan	Nil	Nil	Nil	-	Akbar-19
43.	Do	106M 30.09894 071.18034	Muzafargarh	Nil	60S	Nil	10%	Galaxy-13
44.	Do	125M 30.08570 070.97555	ChowkQureshi by pass	Nil	10 MS	Nil	10%	Galaxy-13
45.	Do	118M 30.08013 070.87257	Ghazi Ghat D.G.Khan	Nil	5MS	Nil	5%	Unknown
46.	Do	109M 30.07259 070.84704	Bait Utra, D.G.Khan	Nil	5MS	Nil	5%	Unknown
47.	Do	112M 29.95879 070.65278	Paigah, D.G.Khan	Nil	5S	Nil	5%	Unknown
48.	Do	112M 29.81256 070.58786	ManaAhmadani	Nil	5S	Nil	5%	Unknown
49.	Do	105M 29.56678 070.55060	Jampur	Nil	10S	Nil	5%	Unknown
50.	Do	113M 29.49357 070.51454	Muhammad Pur	Nil	Nil	Nil	-	Unknown
51.	Do	124M 29.26249 070.43444	FazilPur	Nil	20S	Nil	5%	Unknown
52.	Do	96M 29.07273 070.32682	Rajanpur	Nil	Nil	Nil	-	Unknown
53.	Do	50M 28.94852 070.39880	KotMithan Sharif	Nil	Nil	Nil	-	Unknown
54.	27-02-21	120M 29.46008 071.98362	LalSohanra, Bahawalpur	Nil	20S	Nil	5%	Unknown
55.	Do	113M 29.48623 072.03413	Goth Shah Muhammad	Nil	Nil	Nil	-	Unknown
56.	Do	140M 29.67469 072.44704	QaimPur	Nil	Nil	Nil	-	Unknown
57.	Do	148M 29.69931 072.63359	Chak 57/F , HasilPur	Nil	20MS	Nil	5%	Ghazi-19



58.	Do	186M 29.74403 072.70328	Chak 10/ F	Nil	Nil	Nil	-	Unknown
59.	<b>Do</b>	162M 29.82120 072.90136	Gajiani, Chishtian	Nil	5MS	Nil	5%	Unknown
60.	Do	159M 29.88795 070.00345	ChakMadarsa, Bahawalnagar	Nil	Nil	Nil	-	FSD-08
61.	Do	144M 29.99031 073.20516	Pul Nadir, B.nagar	Nil	Nil	Nil	-	Unknown
62.	Do	149M 29.81999 073.25172	BastiLabhsingh	Nil	Nil	Nil	-	Unknown
63.	Do	151M 29.68400 073.18556	ChakKhatan, Haroon Abad	Nil	Nil	Nil	-	Unknown
64.	Do	140M 29.63264 073.06587	Chak 43/3 R Haroon Abad	Nil	Nil	Nil	-	Unknown
65.	<b>Do</b>	140M 29.56127 072.74192	Chak 165/ M	Nil	5MS	Nil	5%	Unknown
66.	<b>05-03-21</b>	83M 28.79470 070.83534	Feroza, LiaqatPur	Nil	Nil	Nil	-	Unknown
67.	Do	107M 28.59635 070.55185	LiaqatPur area	Nil	Nil	Nil	-	Unknown
68.	Do	83M 28.41366 070.20081	Rahim Yar Khan	Nil	Nil	Nil	-	Unknown
69.	Do	87M 28.26693 070.00880	Machi Goth Sadiq Abad	Nil	Nil	Nil	-	Unknown
70.	Do	75M 28.22378 069.90840	KotSabzal, Sadiq Abad	Nil	Nil	Nil	-	Unknown
71.	Do	78M 28.65170 070.26407	Abad Pur, Rahim Yar Khan	Nil	Nil	Nil	-	Unknown
72.	<b>Do</b>	90M 28.90799 070.43534	Chachran Pull River area	Nil	10Ms	10S	20%	Mixture
73.	Do	87M 28.87592 070.63010	FatehPur Kamal	Nil	Nil	Nil	-	Unknown

74.	Do	90M 29.02464 070.80070	Jan Pur	Nil	Nil	Nil	-	Unknown
75.	Do	89M 29.09777 070.92219	Taranda Muhammad Panah	Nil	Nil	Nil	-	Unknown
76.	<b>12-03-21</b>	110M 29.30565 071.82697	13 BC Bahawalpur	Nil	Nil	Nil	-	Unknown
77.	Do	87M 29.40594 071.82697	DeraBakha	Nil	Nil	Nil	-	Unknown
78.	Do	114M 29.53020 072.14720	KhairPurTamewali	Nil	Nil	Nil	-	Unknown
79.	Do	137M 29.67580 072.34316	QaimPur, HasilPur	Nil	Nil	Nil	-	Unknown
80.	Do	160M 29.67653 072.57459	HasilPur	Nil	Nil	Nil	-	Unknown
81.	Do	207M 29.59238 072.66406	Chak 147/M	Nil	Nil	Nil	-	Unknown
82.	Do	150M 29.43565 072.84999	Chak 441/6R, Haroon Abad	Nil	Nil	Nil	-	Unknown
83.	Do	113M 29.22226 072.80982	77 Moor, Fort Abbas	Nil	Nil	Nil	-	Unknown
84.	Do	127M 29.22544 072.39172	Maroot	Nil	Nil	Nil	-	Unknown
85.	Do	126M 29.18694 072.25321	Mansoorra	Nil	20MS	Nil	-	Unknown
86.	Do	134M 29.21491 071.85265	44DB, Yazman	Nil	Nil	Nil	-	Unknown
87.	<b>13-03-21</b>	98M 29.36806 070.98401	Ali Pur, MuzafarGarh	Nil	20S	Nil	10%	Akbar-19
88.	<b>Do</b>	112M 29.52821 070.86196	Jatoi	Nil	10S	Nil	5%	Akbar-19
89.	<b>Do</b>	124M 29.76016 070.90557	Head Bakaini	Nil	20S	10S	20%	Unknown

90.	<b>Do</b>	113M 30.07731 070.92434	ChowkQureshi D.G.Khan	Nil	5MS	5MS	5%	Mixture
91.	<b>Do</b>	110M 30.07194 070.86105	Ghazi Ghat	Nil	Nil	40S	50%	Sahar-06
92.	<b>Do</b>	115M 29.83753 070.44899	ChotiZareen	Nil	20MSS	20S	30%	Unknown
93.	<b>Do</b>	113M 29.44250 070.49959	Muhammad Pur	Nil	5S	Nil	5%	Unknown
94.	Do	118M 29.31250 070.45866	FazilPur	Nil	Nil	Nil	-	Unknown
95.	Do	120M 29.06789 07032805	RajanPur	Nil	Nil	Nil	-	Unknown
96.	<b>Do</b>	120M 28.94740 070.40661	Chachran Sharif River side	Nil	Nil	20MS	20%	Unknown
97.	<b>14-03-21</b>	113M 29.57632 071.64741	Lodhran Bypass	Nil	Nil	Nil	-	Unknown
98.	Do	106M 29.65206 071.61641	Paluwala, Lodhran	Nil	Nil	Nil	-	Unknown
99.	Do	103M 29.77957 071.46684	KotNijabat, Shujah Abad	Nil	Nil	Nil	-	Unknown
100.	Do	107M 29.81212 071.38302	Raja Ram	Nil	Nil	Nil	-	Unknown
101.	Do	105M 29.78481 071.27222	Peer Ghaib, Shujah Abad	Nil	Nil	Nil	-	Unknown
102.	<b>Do</b>	92M 29.66709 071.25001	Hafiz Wala, Jalal PurOeerwala	Nil	20S	Nil	5%	Unknown
103.	<b>Do</b>	94M 29.43277 071.21364	GajaPura, Jalal PurPeerwala	Nil	10S	Nil	20%	Mixture
104.	Do	102M 29.35712 071.22792	Jhangra	Nil	Nil	Nil	-	Unknown
105.	<b>Do</b>	96M 29.33465 071.27321	Pull Sidiq Abad, Hathaigi	Nil	10MS	20S	10%	Unknown

106.	Do	94M 29.24862 071.39013	Mubarak Pur	Nil	Nil	Nil	-	Unknown
107.	<b>22-02-21</b>	120M 29.18612 072.18154	Muhammad Ali, Mansoor	Nil	Nil	Nil	-	Unknown
108.	Do	143M 29.20771 072.32687	Muhammad Tariq, Chak 340/HR, Marot	Nil	Nil	Nil	-	Unknown
109.	Do	137M 29.22828 072.45950	Ali Raza, Chak 323/HR	Nil	40 S	Nil	10%	AAS-11
110.	Do	159M 29.22804 072.44572	GhulamSarwar, Marot chak 313/HR	Nil	Nil	Nil	-	Unknown
111.	Do	137M 29.22828 072.45950	M. Javeed, marotchak 302/HR	Nil	Nil	Nil	-	Unknown
112.	Do	140M 29.21421 072.89437	M. AamirMushtq, AddaRafiqabad	Nil	Nil	Nil	-	Unknown
113.	Do		M. Zaman , Chak 442/Fateh	Nil	Nil	Nil	-	Unknown
114.	Do	171M 29.55274 072.82222	RanaNaveed, 75 Mor	Nil	Nil	Nil	-	AAS-11
115.	<b>25-02-21</b>	116M N 29.37579 E071.63472	UmairNisar, Adda 42, Yazman	Nil	Nil	Nil	-	Unknown
116.	Do	120M N 29.23928 E071.74142	M. Naveed , Kudwala	Nil	Nil	Nil	-	Unknown
117.	Do	122 M N 29.4425 E071.8835	Liaqatghuman, chak 68, kudwala	Nil	Nil	Nil	-	FSD-08
118.	<b>26-02-21</b>	128M 29.2716 072.9122	M. Imran, Chak 226/9-r, Fortabbas	Nil	Nil	Nil	-	Unknown
119.	Do	136M 29.41369 072.86637	Ghulam Bari, Yateemwali	Nil	Nil	Nil	-	Unknown

This year was entirely different regarding rusts especially yellow rust. Early detection of colony of yellow rust was the focus and it was found that due to different climatic pattern, the spread of yellow rust was limited during crucial month (February). Early sowing and limited area sown to highly susceptible and more infection responsive varieties also had positive contribution this year.

Although, most of the varieties were more or less susceptible to brown and yellow rust but they also enjoyed disease escape this year. Disease outbreak was curtailed also due to timely dissemination of information regarding management actions by agricultural professionals.

#### **11. Screening of mungbean cultivars/lines against mung bean yellow mosaic virus (MYMV)**

Ten (10) mungbean cultivar/lines received from Pulses Section were planted to find out the sources of resistance against Mungbean Yellow Mosaic Virus (MYMV) under natural conditions. The experiment was sown in RCBD with 2 repeats by keeping plot size of 5 m × 1.8 m. One row of highly susceptible check (Mash bean) was planted after every two entries. Presence of the insect vector white fly was also recorded before and on the onset of the disease. Disease data of the Mungbean yellow mosaic virus was recorded as under in Table-11.

**Table 11: Mungbean yellow mosaic virus (MYMV)**

Scale	Infection %	Infection category	Reaction group	No. of entries	Names of Varieties/ Lines
0	0 %	Immune	I	00	00
1	1-10 %	Highly Resistant	HR	00	00
2	11-20 %	Resistant	R	07	BRM-105 BRM-106 BRM-107 BRM-109 NM-2011 BRM-113 AZRI-06
3	21-30 %	Moderately Resistant	MR	03	BRM-103 BRM-110 BRM-111
4	31-50 %	Moderately susceptible	MS	00	00
5	50% and above	Susceptible	S	00	00

Out of 10 cultivars/lines screened out against MYMV, seven (07) exhibited resistant (R) while three (03) showed moderately resistant (MR) reaction.



Fig. 9 Severe attack of mung bean by MYMV

#### 12: Screening of sorghum varieties/lines against grain smut (*Sphacelotheca sorghi*)

Ten (10) varieties/lines were sown on 02.07.2020 in two rows keeping the plot size of 6m × 1.8m in each set. Test entries were infested by dipping in fresh spore suspension of the pathogen for 5 minutes and then incubated for 24 hours at 30°C in order to establish the pathogen intensity. Jowar-319 was used as susceptible check.

Data on the disease incidence were recorded on the basis of diseased and healthy heads at the time of maturity and are tabulated as under (Table -12):

**Table 12: Screening of sorghum varieties/lines against grain smut**

Reaction	Reaction type	No. of entries	Varieties/lines
HR (Highly Resistant)	1	10	YSS-98, BR-319, Jowar-86, S-3, S-14, S-16, S-17, S-18, S-22 and S-5.
R(Resistant)	3	00	00
MR (Moderately Resistant)	5	00	00
MS (Moderately Susceptible)	7	00	00
S ( Susceptible)	9	00	00

Out of 10 varieties/lines of sorghum including check (Jowar-319) screened out against grain smut (*Sphacelotheca sorghi*), all the varieties/ lines fell into highly resistant category. Epidemiological conditions did not give favorable environment to the pathogen.



Fig. 10 Sorghum grains affected by grain smut

### 13. To evaluate guar germplasm resistant against alternaria blight and bacterial blight

Seven (7) entries of guar were sown at Guar Research Station area. The experiment was sown on 20.06.2020 replicated thrice. Plant to plant spacing was kept 60 cm while row to row spacing was kept 30 cm. Disease data were recorded at the time of disease appearance and are given in Table-13.

**Table 13: Data of bacterial blight and alternaria blight**

#### 1. Bacterial blight:

Reaction	Reaction type	No. of entries	Varieties/lines
I (Immune)	0	00	00
R(Resistant)	1(1-10%)	06	S-6159 S-6543 S-6536 S-5823 S-6384 BR-2017
MR (Moderately Resistant)	3(11-25%)	00	00
MS (Moderately Susceptible)	5(26-50%)	01	S-6547
S (Susceptible)	7(51-75%)	00	00
HS (Highly Susceptible)	9 (75 % or Above)	00	00
<b>TOTAL</b>			<b>7</b>

In case of Bacterial Blight, out of seven (07) test entries six (06) showed resistant response while one (01) entry showed moderately susceptible response towards disease.



Fig. 11 Guar leaf affected by bacterial blight

## 2. Alternaria blight:

Reaction	Reaction type	No. of entries	Varieties/lines
I (Immune)	0	00	00
R(Resistant)	1 (1-10%)	01	S-5823
MR (Moderately Resistant)	3 (11-25%)	05	S-6159 S-6543 S-6536 BR-2017 S-6384
MS (Moderately Susceptible)	5 (26-50%)	01	S-6547
S (Susceptible)	7 (51-75%)	00	00
HS (Highly Susceptible)	9 (75 % or Above)	00	00
<b>TOTAL</b>			<b>7</b>

In case of Alternaria Blight out of seven (07) test entries five (05) showed moderately resistant response, one (01) entry showed resistant while one (01) entry showed moderately susceptible response towards disease.





Fig.12 Guar leaf affected by alternaria blight

## ENTOMOLOGY SECTION

### 1. Evaluation of various strains/ varieties of mung bean against whitefly (*Bemesiatabaci*) under non sprayed conditions

The experiment was conducted for screening of Mung bean strains/ varieties for whitefly population under natural field conditions (i.e. non-sprayed). There were ten entries with three replications and plot size of 6.0 m<sup>2</sup>. The experiment was laid out in RCBD. The results are as under:

Strains	Av. Whitefly leaf <sup>-1</sup>
BRM-103	4.0 F
BRM-105	5.28 E
BRM-106	6.73 B
BRM-107	5.98 CD
BRM-109	5.10 E
BRM-110	6.18 C
BRM-111	5.46 DE
BRM-113	5.40 E
AZRI-M-2006	7.46 A
NM-2016	6.31 BC



Fig: 01. Attack of whitefly on Mungbean

The maximum whitefly population per leaf was recorded on strain BRM-106 i.e.6.73 while minimum population of whitefly per leaf was recorded on BRM-103 i.e.4.0

## 2. Response of wheat varieties/ strains against aphids under natural conditions.

The objective of this experiment was to screen out wheat varieties/ strains against aphid under natural field conditions in normal and late sown crop. There were ten entries with a plot size of 4.8 m<sup>2</sup> using RCBD with 3 replications.

The data of aphid / tiller were recorded. The results are given as under:

varieties/ strains	Av. Aphid tiller <sup>-1</sup>	
	Normal planting	Late planting
181601	13.0 de	15.5 e
BF-1705	11.2 e	14.7 e
BF-1805	15.0 bc	18.6 c
BF-1902	14.2 bcd	18.5 cd
BF-1910	15.1 bc	19.2 bc
180003	14.5 bcd	20.1 b
1807	13.7 cd	17.2 d
195715	16.0 b	17.8 cd
Ghazi-19	18.6 a	20.0 b
Fareed-06	20.2a	24.4 a
LSD @ 0.5	1.71	1.34



Fig: 02 Aphid attack on

wheat spike

Maximum population of aphid

/tiller was observed in strain 195715 in normal planting and in late planting, strains 180003 showed maximum aphid population /tiller. Minimum aphid /tillers was observed on BF-1705 in both normal and late planting.

## 3. Efficacy of different plant extracts against aphid on wheat

An experiment was conducted to evaluate the effectiveness of different plant extracts (Neem, Tumba, Tobacco, Moringa and Citrus Peel) against wheat aphid. The experiment was laid out in RCBD along with three replication having plot size of 6 m<sup>2</sup>.

Plant extracts were prepared by soaking 60g leaves of above mentioned plants in muslin cloth bag and soaked in 1liter of water for 24 hours, then sieved the extracts for spray making



20liter volume after adding water in it. Data of aphid population before and after spray were recorded to calculate the percent mortality. The detail is as under:

Fig: 03. Natural control of aphid

Botanicals	Aphid population /tiller	Percentage Population Reduction			AV. % Reduction
		After 24 hr	After 48 hr	After 72 hr	
Neem ( <i>Azadirachta indica</i> )	23	15	21	24	20
Tobacco ( <i>Nicotiana glauca</i> )	21	14	15	20	16.3
Tumma ( <i>Citrullus colocynthis</i> )	22	13	16	19	16
Moringa ( <i>Moringa oleifera</i> )	25	11	13	12	12
Citrus peel	24	9	13	11	11

All the plant extracts showed effectiveness against wheat aphid. Maximum population reduction percentage was recorded with the application of Neem extract i.e. 20% followed by Tobacco and Tumma i.e. 16.0% and 16.3%, respectively.

It can be concluded from the present study that plant extracts have good insecticidal properties especially against soft bodied insects like Aphid and can effectively be used in IPM program because they are environment friendly and easy to prepare and use and are thus cost effective.

#### 4. Efficacy of different insecticides against stem borer (*Chilopartellus*) on sorghum crop.

This experiment was conducted to evaluate ten sorghum varieties/ strains against stem borer under non-sprayed field conditions by using RCBD layout with three replications and plot size of 14.4 m<sup>2</sup>. The %age damage of borer was recorded. The results are given below:

Varieties/ Strains	Av. % damage
RARI-S23	18
RARI-S24	16
RARI-S25	22
RARI-S26	26
RARI-S27	21
RARI-S28	17



RARI-S29	31
<b>Jowar-86 (check)</b>	<b>23</b>
<b>Y-SS-16(check)</b>	<b>25</b>
<b>RARI-S-30</b>	<b>19</b>

Fig: 04 stem borer attack on Sorghum

The average damage percentage ranged from 16-31% due to *Chiloptartellus*.

Maximum damage was found on strain RARI-S-29 i.e. 31% followed by strain RARI-S26 i.e. 26%. RARI-S24 showed minimum damage by borer with average damage of 16%.

#### 5. Efficacy of different insecticides against stem borer (*Chiloptartellus*) on sorghum crop

The experiment was conducted to find out most effective insecticide to control the stem borer. There were five treatments with three replications in RCBD. RARI-S 29 was sown for this purpose using plot size of 7.2 m<sup>2</sup>. Attacked plants were counted before and after spray and damage percentage was calculated. Recommended doses of insecticides were applied on the crop. The results are given below:

Insecticides	Dose/acre (ml)	Mortality %
Lambda cyhalothrin 2.5EC	330	72
Emamection bezoate 1.9EC	200	67
Bifenthrin 10 EC	330	52
Chlorpyrifos 40 EC	600	76
Lufenuran 50 EC	200	65

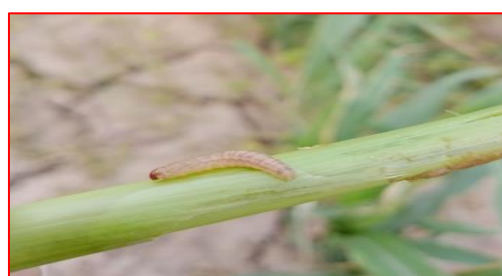


Fig: 05 Stem borar of sorghum

All treatments were found effective. The maximum mortality (76%) was recorded for Chlorpyrifos 40 EC followed by Lambda cyhalothrin 2.5 EC i.e. 72% mortality against stem borer.

#### 6. Screening of brassica against aphids

This experiment was conducted to screen Brassica varieties/ strains against aphid under non-sprayed field conditions. There were 17 entries having 3 replications and plot size of 8.4 m<sup>2</sup>. The experiment was laid out in RCBD and data of aphid population were recorded from 10cm length of inflorescence. The recorded data are given below:

Varieties/Strains	Avg. Aphid/ 10cm Length	
	Normal sown	Late sown
BRJ-1102	14.16 g	19.56 g
BRJ-1669	11.73 h	16.46 h
BRJ-1776	15.01 g	20.74 fg
BRJ-1885	11.80 h	20.12 g





BRJ-1886	14.65 g	21.13 efg
BRJ-1882	18.05 cd	24.57 abc
BRJ-1405	18.00 cd	20.75 fg
BRJ-1304	17.00 ef	23.55 bcd
BRJ-1458	21.20 a	22.61 def
BRJ-1775	15.00 g	23.38 bcd
BRJ-1778	19.01 cd	25.5 a
BRJ-1994	18.68 cd	23.5 bcd
BRJ-1995	17.13 def	24.78 ab
BRJ-1997	18.83 cd	23.16 bcd
BRJ-1993	16.75 f	19.65 g
BWP RAYA	19.75 ab	22.70 cde
SUPER RAYA	20.90 a	23.93 abcd
LSD @ 0.5	1.7	1.92

Fig: 06 Aphid attack on brassica

Minimum aphid infestation was found on BRJ-1669 both in normal sown and late sown conditions. Maximum aphid infestation was observed on strain BRJ-1458(21.2) and BRJ- 1778(25.5) in normal and late plantings, respectively.

## 7. Efficacy of different insecticides against aphid on brassica

The experiment was conducted to find out the efficacy of different insecticides against aphid on brassica.



The experiment was laid out in RCBD along with three replications having plot size 8.4 m<sup>2</sup>. The data of aphid on brassica were recorded before and after spray. The results are given below:

Insecticides	Dose/acre (gram/ml)	Percentage Mortality
Flonicamide 48 SC	60	81.80
Carbosulfan 20 EC	400	77.0
Nitenpyram 10 AS	200	69.0
Imidacloprid 200 SL	200	63.0
Bifenthrin 10 EC	330	68.42

All the insecticides showed promising results. Flonicamide was found to be the most effective against aphid on Brassica with 81.8% mortality followed by Carbosulfan i.e. 77 % mortality against aphid.

## 8. Response of chickpea strains against *Helicoverpa armigera*, under natural field conditions

This experiment was conducted to evaluate the chickpea varieties/ strains against gram pod borer under non-sprayed field conditions. There were eight entries with three replications and plot size of 4.8 m<sup>2</sup>. The trial was conducted according to RCBD. The % damage by gram pod borer was recorded. The results are given below:

Varities/ Strains	Av. Pod damage %age
BRC-526	8.0
BRC-517	11.5
BRC-523	9.7
BRC-505	9.0



BRC-510	10.75
BRC-501	12.63
BRC-424	11.5
BHAKAR-16(check)	13.75

Fig: 08 *Helicoverpaarmigera* attack on chickpea

The average pod damage percentage ranged from 8-13.75% due to *Helicoverpaarmigera*. Maximum damaged pods were observed on BRC-501 (12.63%). BRC-526 showed minimum damage by gram pod borer with average pod damage of 8%.

#### 9. Efficacy of different insecticide against gram pod borer (*Helicoverpaarmigera*)

The experiment was conducted to find out the efficacy of various insecticides against gram pod borer on chickpea. Strain BRC-446 was sown in RCBD with 3 replications having plot size of 4.8 m<sup>2</sup>. Data of pod borer were recorded before and after the application of insecticides. The results are shown in following table:

Insecticides	Dose/acre (gram/ml)	Mortality %
Emmamectin benzoate 1.9 EC	200	64
Chlorpyrifos 40 EC	800	72
Lambdacyhalothrin 2.5 EC	330	60
Flubendiamide 48 SC	80	55
Chlorantraniliprole20 SC	50	75



Fig: 08 *Helicoverpaarmigera* attack on chickpea

All the tested insecticides were found effective in controlling the gram pod borer. However, maximum mortality i.e.75 percent was observed byChlorantraniliprole20 SC followed by Chlorpyrifos 40 ECi.e.72 percent.

#### 10. Efficacy of different insecticides against thrips on onion crop

The experiment was conducted to find out the efficacy of different insecticides against thrips. The experiment was laid out in RCBD with plot size of 6.0 m<sup>2</sup> with three replications. The data of thrips were recorded before and after spray by counting thrips population per leaf. All the



insecticides proved effective. The percentage mortality of insecticides given below:

Insecticides	Dose/acre (gram/ml)	Percentage Mortality
Chlorfenapyre 360 SC	200	55.62
Spintoram 120 SC	100	69.52
Dimethate 120 SC	400	52.65
Imidachloprid 200 SL	200	36.32
Gamacyhalothrin 60 CS	100	50.74

Fig: 10 Thrips attack on Onion

All the tested insecticides showed better results. The maximum control was recorded by the insecticide Spintoram 120 SC and Chlorfenapyre 360 SC which gave 69.52% and 55.62% mortality, respectively.

### 11. Screening of new guar strains against insect pests

The objective of this experiment was to screen out Guar strains against insect pest under natural field conditions. There were five entries with plot size of 16.2 m<sup>2</sup> using RCBD with 3 replications. The data of sucking insect per leaf were recorded from upper, middle, and lower leaves. The results are given as under:

Varieties/ Strains	Av. Population leaf <sup>1</sup>	
	Jassid	Whitefly
S-6159	0.44	3.82
S-6543	0.62	4.00
S-6536	0.55	4.55
S-6547	0.72	4.71
BR-2017 (check)	0.81	4.82



Fig: 11 Jassad and whitefly attack on Guar

All the tested Guar strains showed tolerance against insect pest. Maximum population of jassid (0.72/ leaf) and whitefly (4.71/ leaf) were recorded on strain S-6547. The attack of bollworm was not found on guar strains.

## PROJECTS

**Project no. PARB-911** “Diversification of cropping by promotion of Wheat (*Triticum aestivum*), Sohanjna (*Moringa olifera*), Castor Bean (*Ricinus communis*), Taramera (*Eruca sativa*), Mustard (*Brassica juncea*), Pearl Millet (*Pennisetum glaucum*) & Sesame (*Sesamum indicum*) in lesser Cholistan”

It was funded by PARB for three years i.e. 2017-18 to 2019-20. This project was ended on 30.10.2020.

**Project no. PARB-904** “Nutrition enhancement of crops, fruits, vegetables and their products under climate change scenario”.

## FARMERS DAYS

Two farmer days were organized to create awareness among the farmers about research activities at RARI, Bahawalpur dated: 29.10.2020 and 24.02.2021. A large number of farmers participated in farmers days. They were briefed about the research activities and achievements of the Institute, which were appreciated by them.

## **INTERNSHIP OF STUDENTS**

The students of final year of BSc (Hons) Agriculture from various agricultural universities/colleges are sent to this institute for their internship. The students conduct research projects under the supervision of research scientists of this institute.

## **VISIT OF DIGNITARIES**

### **Thakur Parsaud Tiwari (CIMMYT) 11.03.2021**

#### **Comments**

This is my first visit to Regional Agricultural Research Institute, Bahawalpur as part of my job introductory visit Dr. Lal and his team briefed all activities and achievements followed by field visit. I was very much impressed the way they are working as a team. Experimental plots and seed multiplication of released and pre-released material were managed well. It was possible due to their team work and dedicated efforts. I am thankful for their joint presentation and briefing. Also thankful to the hospitality provided to me and also acknowledging CIMMYT support. Best wishes. TP

**Dr. Muhammad Mansoor, National Coordinator (Pulses) & PD, PSDP, Pulses, Project PSD, PARC (19.03.2.21)**

#### **Comments**

It was my first visit of RARI Really, I found this institute as an assets for country having multiple domains of research and development.

Varieties released by RARI, Scientists are really best performing and especially, I would like to say that it is a productive institute having strong scientist team. In spite of shortage of technical human resource, the institute performing its command area. Chickpea Desi + Kabuli variety and candidate lines are very promising. Hope this institute will contribute more varieties in NARS. Best wishes for scientist and institute.

## **CLIMATIC DATA**

Month	Temperature (°C)		Rainfall (mm)	Humidity %
	Minimum	Maximum		



July, 2020	22	42	83	76
August, 2020	25	42	127	79
September, 2020	37	25	-	78
October, 2020	26	35	-	81
November, 2020	18	32	-	85
December, 2020	06	14	-	73
January, 2021	05	17	-	88
February, 2021	12	30	-	80
March, 2021	19	36	18	79
April, 2021	22	40	02	71
May, 2021	24	43	04	85
June, 2021	25	48	37	82

## TRAININGS OBTAINED

Name of Officer	Title of Training	Host Institute,	Duration
Mr. Abid Ali (Scientific Officer)	Financial management	RADEC Vehari	02.12.2020 to 04.12.2020
Mr. Abid Ali (Scientific Officer)	Project preparation, monitoring and evaluation	RADEC Vehari	08.02.2021 to 10.02.2021
All Scientist of RARI, BWP	Wheat productivity enhancement	RARI, Bahawalpur	29.10.2020

## PUBLICATIONS

1. Rizwan Muhammad, Jehanzeb Farooq, Muhammad Farooq, Aqeel Sarwar, Abid Ali, Farrukh Ilahi, Muhammad Asif, and Ghulam Sarwar. (2021). "Quantitative Studies in Upland Cotton (*Gossypium hirsutum* L.) using Multivariate Techniques." *Pak.J. Agri. Res.* Vol.34, no. 1pp.113-119.
2. Anum, W., Liaqat,A.,Riaz, U., Ali, A., Manzoor, N., Akhtar, L. H., Rehman, A., Maan,N.,&Ahmad.2020. Envasaging the response of wheat under different phosphorous doses and methods of application. *Pak. J. of Agri. Research..volume. 33* (pp 395-402)
3. Rehman, Mashal, Lal Hussain Akhtar, Ali Bakhsh, Wajiha Anum, Kiran Tariq, Muhammad Zubair, Madiha Mobeen Khan et al.2021 "Estimation of varietal differences for grain quality traits in wheat under two different irrigation regimes."
4. Riaz, Umair, Ghulam Murtaza, Wajiha Anum, Tayyaba Samreen, Muhammad Sarfraz, and Muhammad Zulqernain Nazir. 2021 "Plant Growth-Promoting Rhizobacteria (PGPR) as biofertilizers and biopesticides." In *Microbiota and Biofertilizers*, pp. 181-196. Springer, Cham.
5. Riaz, Umair, Humera Aziz, Wajiha Anum, Shahzada Munawar Mehdi, Ghulam Murtaza, and Moazzam Jamil. 2020 "Biofortification Technologies Used in Agriculture in Relation to Micronutrients." In *Plant Micronutrients*, pp. 225-239. Springer, Cham.

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10. Rafiq, M., Mahmood, M. T., Ahmad, M., Ali, I., Saleem, M., Rasool, I., & Ali, Z. (2020). Differential response of elite chickpea genotypes under moisture stress conditions. *Pak. J. Agric. Res*, 33, 422-428.
11. Hafeez, Z., Shah, S. A. H., Shahid, M. I., & Bashir, M. A. (2020). Asexual propagation of most promising genotypes of jojoba *Simmondsia chinensis*. *World Journal of Biology and Biotechnology*, 5(2), 43-45.
12. Umair riaz, Shazia Riaz, Fizan rafi, madha batool, nadia manzoor, Waqas Ashraf and ghulam murtaza (2021). "Microbiota and biofertilizers, values of composting", Vol 2 pp 175-193.

## **RADIO/TV TALKS**

The Scientists of this institute participates in different Radio/TV talks according to the government schedule. They delivered talks on field problems and issues of farmers. They also replied the farmer calls in live program.

