

# 1. TOMATO (*Solanum lycopersicum*)

## 1.1 MAINTENANCE OF GENE POOL

179 genotypes of both determinate (118) and indeterminate (61) types of local and exotic origins were sown for the purpose of maintenance. The nursery of indeterminate genotypes was sown on 14.10.2015 and transplanted on 04.12.2015 whereas; the nursery of determinate genotypes was sown on 28.10.2015 and transplanted on 08.12.2015. The plot size was kept as 3.70 × 0.85 m and 7.0 × 1.25 m for indeterminate and determinate genotypes respectively. The detailed below entries were maintained during the year:

**Table-1 Maintenance of Tomato Germplasm Lines / Varieties**

DETERMINATE					
S. No.	Entry	S. No.	Entry	S. No.	Entry
1	Big Beef	41	AVTOV-1008	80	10140
2	Bonita	42	AVTOV-1009	81	10142
3	Glacier	43	HM-2855-8-0-15	82	10143
4	Jaguar	44	Hydroponics-12-1-11-9-7	83	10164
5	Legend	45	Hydroponics-12-1-11-9-11	84	10168
6	Nadir	46	L00184	85	10170
7	Nagina	47	L00492	86	10173
8	Naqeeb	48	L00493	87	10174
9	Pakit	49	L00525	88	10178
10	Polar Baby	50	L00587	89	10179
11	Polar Beauty	51	L00602	90	10186
12	QF Red	52	L01214	91	10187
13	Rio Grande	53	L01225	92	13189
14	Rokker	54	LO-2752-Rio Fuego-33-1-5-6	93	13198
15	Roma	55	LO-2752-Rio Fuego-33-1-5-3-0-4	94	13201
16	Speckled Siberian	56	LITTH-559-17-5-1-2 (Det)	95	13205
17	Sub Arctic	57	LITTH-559-17-5-1-2-4-8 (Det)	96	13209
18	UC-134	58	Lyp. No. 1	97	13210
19	Zarnitza	59	NB-242	98	13211
20	Zhezha	60	NTH-242	99	13213
21	AUT-302	61	NUYT-701	100	13215
22	AUT-305	62	QF-Red-Rio Fuego-2-1-5-4-7	101	13219
23	AUT-309	63	Rio Grande- 08542-40-1-3-6-2	102	13220
24	AUT-313	64	Savera-2-4-2-3-7	103	13221
25	AUT-315	65	Savera-2-4-2-4-6	104	13226
26	AUT-318	66	Savera-2-4-2-4-8	105	13227
27	AUT-319	67	T-1359-2-1-4	106	13228
28	AUT-320	68	TAI-687/786-6-3-15-3	107	13229
29	AUT-321	69	TAI-687/786-6-3-15-7-6-2	108	13230

30	AUT-322	70	Yaqui-4	109	13231
31	AUT-323	71	Yaqui-5-1	110	13232
32	AUT-324	72	Yaqui-5-2	111	13233
33	AUT-325	73	Yaqui-9	112	13234
34	AUT-326	74	07040	113	13235
35	AUT-327	75	09065	114	13236
36	AUT-330	76	10114	115	13237
37	AUT-331	77	10116	116	13238
38	AUT-332	78	10137	117	13239
39	AUT-333	79	10139	118	13240
40	AUT-339				
<b>INDETERMINATE</b>					
<b>S. No.</b>	<b>Entry</b>	<b>S. No.</b>	<b>Entry</b>	<b>S. No.</b>	<b>Entry</b>
1	Bloody Butcher	22	LITTH-539-4-8-6-2-7	42	Salar-16-8-9-6-1-4
2	Brandywine Pink	23	LITTH-539-4-8-6-3-2	43	Salar-16-8-9-6-1-7
3	Chocolate Cherry	24	LITTH-539-4-8-6-3-7	44	Salar-16-8-9-6-1-9
4	Debarao	25	LITTH-539-4-8-6-3-9	45	Salar-16-8-9-6-2-4
5	Gigantesque	26	LITTH-539-4-8-6-3-11	46	Salar-16-8-9-6-2-10
6	Ile's Yellow Latvian	27	LITTH-539-4-8-7-6-9	47	Salar-16-8-9-6-2-11
7	Independence Day	28	LITTH-539-4-8-8-4-9	48	Soberano-6-4-9 (Ind.)
8	Jaffa	29	NSX-6658 (Oblong)	49	TAI-687/786-6-3-15-3 (Ind.)
9	Kornesevsije	30	NSX-6658-SPS-1	50	TAI-687/786-6-3-15-3-1 (Ind.)
10	Matina	31	NSX-6658-SPS-2	51	TAI-687/786-6-3-15-6-4 (Ind.)
11	Pantano	32	NSX-6658-Bulk	52	TAI-687/786-6-3-15-6-13 (Ind.)
12	Slicing Mix	33	NSX-6658-Bulk-2	53	TAI-687/786-9-6-10-0 (Ind.)
13	Sweet William	34	Salar-11-8-2-1-1-3	54	08502
14	Traveller-76	35	Salar-11-8-2-1-1-9	55	08504
15	H. Gold-2-2-6-1	36	Salar-11-8-2-1-7	56	08505
16	H. Gold-12-2-6-1-1	37	Salar-11-8-9-4-7	57	08506
17	LITTH-539-4-8-4-4-1	38	Salar-16-8-9-1-2-5	58	08517
18	LITTH-539-4-8-4-2-7	39	Salar-16-8-9-4-1-0	59	08543
19	LITTH-539-4-8-4-2-9	40	Salar-16-8-9-4-3-9	60	08581
20	LITTH-539-4-8-5-2-7	41	Salar-16-8-9-4-7-2	61	08594 [NSX-6658 (H. Oblong)]
21	LITTH-539-4-8-5-1-9				

## 1.2 HYBRIDIZATION

### A. CROSSING WORK TO CREATE GENETIC VARIABILITY

To develop high yielding tomato varieties possessing tolerance against biotic and abiotic stresses, nursery of 20 parents each of indeterminate and determinate types was sown on 28.10.2015 and 20.10.2015 respectively. Indeterminate type was transplanted on

04.12.2015 whereas; determinate type was transplanted on 08.12.2015 in crossing blocks to create genetic variability for the selection of desired progenies as well as for heterosis studies. Crosses were attempted to produce F<sub>0</sub> hybrid seed suitable for open field and under tunnel cultivation. The detail of successful cross combinations is presented in table below.

**Table-2 List of tomato crosses (F<sub>0</sub>) made during 2015-16**

INDETERMINATE						DETERMINATE			
S. No.	Hybrid	S. No.	Hybrid	S. No.	Hybrid	S. No.	Hybrid	S. No.	Hybrid
1	Salar F <sub>1</sub>	29	LITTH-835	56	LITTH-862	1	Ahmar Hybrid	28	LTH-424
2	Saandal F <sub>1</sub>	30	LITTH-836	57	LITTH-863	2	LTH-252	29	LTH-425
3	Sundar Hybrid	31	LITTH-837	58	LITTH-864	3	LTH-287	30	LTH-426
4	LITTH-611	32	LITTH-838	59	LITTH-865	4	LTH-297	31	LTH-427
5	LITTH-682	33	LITTH-839	60	LITTH-866	5	LTH-324	32	LTH-428
6	LITTH-691	34	LITTH-840	61	LITTH-867	6	LTH-359	33	LTH-429
7	LITTH-731	35	LITTH-841	62	LITTH-868	7	LTH-371	34	LTH-430
8	LITTH-738	36	LITTH-842	63	LITTH-869	8	LTH-372	35	LTH-431
9	LITTH-778	37	LITTH-843	64	LITTH-870	9	LTH-373	36	LTH-432
10	LITTH-780	38	LITTH-844	65	LITTH-871	10	LTH-377	37	LTH-433
11	LITTH-782	39	LITTH-845	66	LITTH-872	11	LTH-387	38	LTH-434
12	LITTH-790	40	LITTH-846	67	LITTH-873	12	LTH-391	39	LTH-435
13	LITTH-793	41	LITTH-847	68	LITTH-874	13	LTH-395	40	LTH-436
14	LITTH-794	42	LITTH-848	69	LITTH-875	14	LTH-397	41	LTH-437
15	LITTH-796	43	LITTH-849	70	LITTH-876	15	LTH-411	42	LTH-438
16	LITTH-797	44	LITTH-850	71	LITTH-877	16	LTH-412	43	LTH-439
17	LITTH-798	45	LITTH-851	72	LITTH-878	17	LTH-413	44	LTH-440
18	LITTH-799	46	LITTH-852	73	LITTH-879	18	LTH-414	45	LTH-441
19	LITTH-801	47	LITTH-853	74	LITTH-880	19	LTH-415	46	LTH-442
20	LITTH-804	48	LITTH-854	75	LITTH-881	20	LTH-416	47	LTH-443
21	LITTH-806	49	LITTH-855	76	LITTH-882	21	LTH-417	48	LTH-444
22	LITTH-816	50	LITTH-856	77	LITTH-883	22	LTH-418	49	LTH-445
23	LITTH-818	51	LITTH-857	78	LITTH-884	23	LTH-419	50	LTH-446
24	LITTH-826	52	LITTH-858	79	LITTH-885	24	LTH-420	51	LTH-447
25	LITTH-827	53	LITTH-859	80	LITTH-886	25	LTH-421	52	LTH-448
26	LITTH-832	54	LITTH-860	81	LITTH-887	26	LTH-422	53	LTH-449
27	LITTH-833	55	LITTH-861	82	LITTH-888	27	LTH-423	54	LTH-450
28	LITTH-834								

**B. PRODUCTION OF INDETERMINATE TOMATO HYBRID SEED SUITBLE FOR HIGH TUNNEL CULTIVATION**

Four (4) indeterminate tomato parental lines were sown on 14.10.2015 and transplanted on 25.11.2015 on an area of four kanals. Three different cross combinations were attempted to produce the seed of three approved indeterminate tomato hybrids i.e.

Salar F<sub>1</sub>, Saandal F<sub>1</sub> and Sundar Hybrid. A combined weight of 2.5 kg of indeterminate tomato hybrid seed suitable for high tunnels cultivation was produced for general cultivation in Punjab.

### 1.3 STUDY OF FILIAL GENERATIONS

To advance the generations of indeterminate type, the nursery of different segregating generations was sown on 14.10.2015 and transplanted on 19.11.2015 under tunnels for the selection of high yielding lines possessing tolerance against biotic and abiotic stresses in different plot sizes according to the availability of seed. Similarly, the nursery of different segregating generations of determinate type was sown on 20.10.2015 and transplanted on 03.12.2015 in open field. The desired progenies/ lines were selected and the detail of generations/ no. of selected progenies is given below:

**Table-3 Study/ Selection of Progenies from Filial Generations**

S. No.	Cross	Single Plant Progenies Selected
<b>a) INDETERMINATE TYPES</b>		
<b>F<sub>2</sub> Generations</b>		
1	08506 × 08504	1
2	08517 × 08504	1
3	Sahel-2-3-2 × 08504	1
4	08504 × Legend	1
5	08585 × 08503	1
6	08553 × 08582	1
7	Matina × 08582	1
8	H. Gold-2-2-6-1 × 08503	1
9	Gigantesque × 08504	1
10	QF-Red × 08543	5
11	NSX-6658 × 08504	3
12	Realeza *	2
<b>F<sub>3</sub> Generations</b>		
1	Merion × 08504	1
2	Traveller-76 × 08504	1
3	NSX-6658 (H. Oblong) × 08504	4
4	Salar *	7
5	Anna *	18
6	Amazon *	1
<b>F<sub>4</sub> Generations</b>		
1	Gigantesque × 08504	21
2	Merion × 08504	1

3	Manapal × 08504	2
4	Carmello × 08504	2
5	Anna *	1
6	Sahel *	4
<b>F<sub>5</sub> Generations</b>		
1	08542 × 08504	2
2	08553 × 08504	3
3	Soberano *	5
<b>F<sub>6</sub> Generations</b>		
1	Sahel *	2
<b>F<sub>7</sub> Generations</b>		
1	08542 × 08504	12
2	Salar *	13
<b>b) DETERMINATE TYPES</b>		
<b>F<sub>2</sub> Generations</b>		
1	Nadir × Grushovka	5
2	Yaqui-5-1 × Grushovka	6
3	Naqeeb × Grushovka	6
4	Beaverlodge Slicer × 10184	4
5	Badin	1
6	Morelia *	3
7	MDS-Red Diamond *	7
8	MDS- Royal Star *	2
9	Kanwal *	6
10	Advanta-1225 *	1
11	RS-1312 *	5
12	GHT-2 *	3
13	HM-2855 *	4
<b>F<sub>3</sub> Generations</b>		
1	Grushovka × Napoli	4
2	Forme de Coeur × 17-07 (07030)	8
3	Amazon *	2
4	Gemco Star *	1
5	Baby Red *	2
6	AS-2565 *	7
7	TO-1057 *	9
<b>F<sub>4</sub> Generations</b>		
1	Pony Express *	12
2	Gemco Star *	8
3	Alankar *	2
4	Cluster-805 *	2
5	Advanta-1242/A	7
<b>F<sub>5</sub> Generations</b>		
1	AVTOV-1002 × LO-2752	61
2	LO-2752 × Yaqui-5-1	2

3	Soberano *	2
<b>F<sub>6</sub> Generations</b>		
1	Rio Grande × Nadir	1
2	Rio Grande × 08542	1
3	QF Red × Rio Fuego	1
4	TAI-687/786 *	1
5	TAI-1757 *	1
<b>F<sub>7</sub> Generations</b>		
1	Rio Grande × 08542	1
2	LO-2752 × Rio Fuego	1
3	QF Red × Rio Fuego	1
4	Saandal (Det.) *	1
5	Hydroponics	2
6	TAI-687/786 *	1
7	Savera *	2

\* Commercial Variety/ Hybrid

#### 1.4 PRELIMINARY EVALUATION OF DETERMINATE TOMATO LINES

To evaluate the yield performance of newly selected lines from segregating generations, a trial comprising of 15 advanced lines along with two check varieties viz: Naqeeb and Rio Grande was conducted at Vegetable Research Institute, Faisalabad. The nursery was sown on 16.10.2015 and transplanting was done on 27.11.2015 according to Randomized Complete Block Design (RCBD) with three replications in a plot size of 7.0 × 1.25 m with plant to plant distance of 50 cm. Data recorded for fruit length, fruit width, fruit weight, fruit firmness and fruit yield is presented in the table below.

**Table-4 Performance of Determinate Tomato Advanced Lines in Preliminary Yield Trial at VRI, Faisalabad during 2016-17**

Rank	Entry	Fruit length (mm)	Fruit width (mm)	Fruit firmness (kg/cm <sup>2</sup> )	Fruit weight (g)	Fruit yield (t/ha)
1	13229	57.5	46.9	3.60	75.8	34.62
2	13240	44.3	42.2	3.66	61.8	34.00
3	13234	62.1	47.4	3.70	86.8	31.01
4	13232	60.0	48.9	3.22	92.6	30.30
5	13236	46.3	40.8	2.94	58.0	28.39
6	13230	60.3	46.0	3.06	85.4	27.34
7	13235	54.3	47.6	3.18	75.2	26.66
8	13231	55.1	45.0	3.50	73.2	25.27
9	<b>Naqeeb (Check)</b>	<b>60.6</b>	<b>51.3</b>	<b>3.96</b>	<b>85.2</b>	<b>25.13</b>
10	13226	58.3	47.9	3.54	80.6	24.72
11	<b>Rio Grande (Check)</b>	<b>57.9</b>	<b>48.5</b>	<b>4.06</b>	<b>80.8</b>	<b>24.03</b>

12	13233	55.5	46.0	3.62	72.4	23.20
13	13227	55.5	44.1	3.62	83.2	23.03
14	13237	48.3	42.4	3.92	59.4	19.53
15	13239	55.7	51.4	4.04	92.2	18.40
16	13228	57.2	47.8	3.16	80.0	16.49
17	13238	53.6	48.0	3.36	82.8	13.21
<b>LSD (0.05)</b>						<b>2.24</b>

The perusal of table indicates that differences among means for fruit yield due to varieties were significant. Entries ranked from No. 1 – 5 produced statistically significant higher fruit yields than the high yielding check Naqeeb (25.13 t/ha). The entries ranked from 3 – 8 and 10 – 13 were statistically at par in terms of fruit yields against the higher check Naqeeb. The highest fruit yield was produced by the entry 13229 (34.62 t/ha) whereas the lowest fruit yield was given by the entry 13238 (13.21 t/ha).

#### **1.5 SECONDARY / STATION YIELD EVALUATION OF DETERMINATE TOMATO ADVANCED LINES**

An experiment comprising of six advanced lines along with two checks namely Naqeeb and Rio Grande was sown in nursery on 16.10.2015 and transplanted on 27.11.2015 in a Randomized Complete Block Design with three replications. The plot size was kept as 7.0 × 1.25 m with plant to plant distance of 50 cm. Data recorded for fruit length, fruit width, fruit weight, fruit firmness and fruit yield is given in the table below.

**Table-5 Performance of Determinate Tomato Advanced Lines in Station Yield Trial at VRI, Faisalabad during 2015-16**

<b>Rank</b>	<b>Entry</b>	<b>Fruit length (mm)</b>	<b>Fruit width (mm)</b>	<b>Fruit firmness (kg/cm<sup>2</sup>)</b>	<b>Fruit weight (g)</b>	<b>Fruit yield (t/ha)</b>
1	13198	57.8	49.6	3.96	88.2	26.40
2	<b>Naqeeb (Check)</b>	<b>59.8</b>	<b>50.1</b>	<b>4.08</b>	<b>84.4</b>	<b>25.38</b>
3	13201	40.8	44.1	3.82	58.6	24.54
4	13213	52.7	47.7	3.78	74.6	22.98
5	<b>Rio Grande (Check)</b>	<b>58.8</b>	<b>50.6</b>	<b>4.26</b>	<b>82.8</b>	<b>22.94</b>
6	13209	50.0	46.9	3.74	73.0	20.99
7	13215	52.3	47.3	3.62	73.0	19.46
8	13211	48.4	47.2	4.02	71.2	18.70
<b>LSD (0.05)</b>						<b>1.95</b>

It is evident from the above table that differences among means for fruit yield due to varieties were significant. The entries ranked at No. 1 and 3 produced statistically at par fruit yields against the highest yielding check Naqeeb (25.38 t/ha). The highest fruit yield performance was shown by the entry named as 13198 (26.40 t/ha) whereas the lowest fruit yield was depicted by the entry namely 13211 (18.70 t/ha).

## 1.6 MULTI-LOCATIONAL / ZONAL EVALUATION OF DETERMINATE TOMATO ADVANCED LINES

To evaluate the yield performance of determinate tomato advanced lines under different ecological zones of Punjab, a trial comprising of six (6) entries along with two checks (Naqeeb and Rio Grande) was conducted at four different locations viz; VRI Faisalabad, VRSS Sheikhpura, VRSS Multan and RARI Bahawalpur. The nursery of these lines was sown on 16.10.2015. The transplanting of the nursery was done according to RCBD in 3 replications and plant to plant distance was kept as 50 cm. The data recorded for fruit yield is given in tables below.

Location	Transplantation Date	Plot Size
VRI, Faisalabad	27.11.2015	7.0 × 1.25 m
VRSS, Sheikhpura	24.11.2015	7.0 × 1.25 m
VRSS, Multan	01.12.2015	7.0 × 1.25 m
RARI, Bahawalpur	02.12.2015	7.0 × 1.25 m

**Table-6 Performance of Determinate Tomato Advanced Lines in Multi-locational / Zonal Trials at VRI, Faisalabad during 2015-16**

Rank	Entry	Fruit length (mm)	Fruit width (mm)	Fruit firmness (kg/cm <sup>2</sup> )	Fruit weight (g)	Fruit yield (t/ha)
1	10139	56.0	49.3	3.94	80.6	33.50
2	10173	56.2	50.3	3.78	77.4	30.05
3	Nadir	58.8	51.0	3.90	83.2	26.36
4	10142	56.1	51.7	4.14	91.4	25.42
<b>5</b>	<b>Naqeeb (Check)</b>	<b>58.6</b>	<b>50.2</b>	<b>3.94</b>	<b>86.2</b>	<b>24.53</b>
6	NB-242	62.1	41.7	3.70	70.2	24.26
<b>7</b>	<b>Rio Grande (Check)</b>	<b>60.1</b>	<b>52.2</b>	<b>4.10</b>	<b>85.8</b>	<b>23.74</b>
8	13189	55.7	49.0	3.80	78.0	17.25
<b>LSD (0.05)</b>						<b>2.54</b>

It is evident from the above table that differences among means for fruit yield due to varieties were significant. Two top ranked entries namely 10139 (33.50 t/ha) and



10173 (30.05 t/ha) produced significantly higher fruit yields as compared with the high yielding check Naqeeb which exhibited the fruit yield of 24.53 t/ha. Entries ranked from No. 3 – 4 and 6 – 7 performed statistically at par in terms of fruit yield as compared with the higher check Naqeeb. The lowest fruit yield of 17.25 t/ha was shown by the entry 13189.

**Table-7 Performance of Determinate Tomato Advanced Lines in Multi-locational / Zonal Trials at Different Locations during 2015-16**

Rank	Entry	Fruit yield (t/ha)				
		FSD	S. Pura	Multan	B. Pur	Average
1	10139	33.50	30.08	29.03	21.81	28.61
2	10173	30.05	28.84	27.60	19.62	26.53
3	10142	25.42	26.91	25.50	15.96	23.45
4	Nadir	26.36	25.22	23.92	18.08	23.40
5	NB-242	24.26	23.98	21.66	-	23.30
<b>6</b>	<b>Naqeeb (Check)</b>	<b>24.53</b>	<b>22.95</b>	<b>21.89</b>	<b>17.18</b>	<b>21.64</b>
<b>7</b>	<b>Rio Grande (Check)</b>	<b>23.74</b>	<b>19.70</b>	<b>18.34</b>	<b>12.95</b>	<b>18.68</b>
8	13189	17.25	20.86	16.78	13.28	17.04
	<b>LSD (0.05)</b>	<b>2.54</b>	<b>1.61</b>	<b>2.48</b>	<b>1.87</b>	<b>-</b>

It is evident from the above table that differences amongst means for fruit yield due to varieties were significant at all locations. On average basis, top five advanced lines produced higher fruit yields than the highest yielding check Naqeeb which gave average fruit yield of 21.64 t/ha. The highest and lowest average fruit yields were depicted by the entries 10139 (28.61 t/ha) and 13189 (17.04 t/ha) respectively.

## **1.7 EVALUATION OF EXOTIC TOMATO VARIETIES/ HYBRIDS IN ADAPTABILITY TRIAL**

### **A. DETERMINATE TYPES**

Ninety seven (97) exotic determinate tomato varieties/ hybrids received from different Seed Companies were tested along with two checks namely TAI-1757 F<sub>1</sub> (exotic) and Naqeeb (local) in four sets for their performance in adaptability trial at Vegetable Research Institute, Faisalabad during Rabi, 2015-16. The nursery was sown and transplanted in a Randomized Complete Block Design with two replications. The recommended agronomic and plant protection measures were adopted to maintain the crop. Data recorded for fruit length, fruit width, fruit firmness, fruit weight and fruit yield is presented below.

**Table-8 Performance of Exotic Determinate Tomato Varieties/ Hybrids in  
Adaptability Trial at VRI, Faisalabad during 2015-16  
Set-1**

Date of nursery sowing: 16.10.2015  
Date of transplanting: 26.11.2015  
Plot size: 8.0 × 1.25 m  
Plant to plant distance: 50 cm

Rank	Variety/ Hybrid	Fruit length (mm)	Fruit width (mm)	Fruit firmness (kg/cm <sup>2</sup> )	Fruit weight (g)	Fruit yield (T/ha)
1	Kamaal F <sub>1</sub>	52.7	47.0	3.16	88.0	34.13
2	Mishal F <sub>1</sub>	49.2	45.9	3.08	61.0	30.39
3	Roshan F <sub>1</sub>	52.6	48.6	3.12	71.0	28.90
4	AS-6484 F <sub>1</sub>	50.5	46.2	3.04	61.0	26.84
5	TO-1080	48.7	46.4	2.90	64.0	26.41
6	Kortaja F <sub>1</sub>	61.9	54.9	3.26	98.0	25.73
7	AS-3877 F <sub>1</sub>	53.5	52.0	3.30	80.0	25.47
8	Maharaja F <sub>1</sub>	51.8	44.6	3.58	60.0	25.20
9	TO-1057	50.8	48.2	3.32	67.0	24.86
10	Buraak F <sub>1</sub>	63.7	47.2	3.20	79.0	24.41
11	575 F <sub>1</sub>	53.1	48.5	3.24	70.0	24.25
12	Yaqoot F <sub>1</sub>	50.7	43.8	3.18	58.0	24.10
<b>13</b>	<b>Naqeeb (Check)</b>	<b>62.4</b>	<b>50.9</b>	<b>3.60</b>	<b>82.0</b>	<b>23.53</b>
14	Miracle F <sub>1</sub>	56.0	48.1	3.44	76.0	23.46
15	BPVT-14-1	52.6	43.4	3.20	56.0	23.45
16	TO-1070	48.6	49.3	2.66	65.0	23.27
17	HT-1570 F <sub>1</sub>	54.2	51.6	3.10	87.0	23.14
18	HT 1914 F <sub>1</sub>	52.8	54.1	3.46	86.0	22.83
19	TO-830	62.5	55.6	2.74	110.0	22.68
20	Indigo F <sub>1</sub>	54.3	47.2	3.24	72.0	22.67
21	BPVT-15-1	52.8	58.0	2.54	106.0	22.11
22	Holland-1 F <sub>1</sub>	59.6	46.4	3.70	71.0	21.68
23	TM-013	61.3	49.9	3.14	83.0	21.56
24	Qasba F <sub>1</sub>	48.6	60.9	3.14	120.0	18.84
<b>25</b>	<b>TAI-1757 F<sub>1</sub> (Check)</b>	<b>50.4</b>	<b>47.7</b>	<b>3.52</b>	<b>65.0</b>	<b>18.07</b>
26	Foster F <sub>1</sub>	49.3	52.4	2.84	77.0	16.64
27	Rebecca F <sub>1</sub>	64.1	44.9	3.08	69.0	15.66
28	Kannon F <sub>1</sub>	65.6	46.0	3.28	129.0	12.39
29	Maryam F <sub>1</sub>	56.6	51.6	3.30	84.0	10.75
<b>LSD (0.05)</b>						<b>2.01</b>

It is evident from the above table that the six entries ranked 1 – 6 produced significantly higher fruit yields than high yielding check Naqeeb (23.53 t/ha). However, entries ranked from 7 – 12 and 14 – 23 remained statistically at par in comparison with

high yielding check Naqeeb. The highest fruit yield of 34.13 t/ha was recorded in entry Kamaal F<sub>1</sub> while the lowest fruit yield was depicted by the entry Maryam F<sub>1</sub> (10.75 t/ha).

**Table-9 Performance of Exotic Determinate Tomato Varieties/ Hybrids in Adaptability Trial at VRI, Faisalabad during 2015-16**  
**Set-2**

Date of nursery sowing: 16.10.2015  
Date of transplanting: 26.11.2015  
Plot size: 8.0 × 1.25 m  
Plant to plant distance: 50 cm

Rank	Variety/ Hybrid	Fruit length (mm)	Fruit width (mm)	Fruit firmness (kg/cm <sup>2</sup> )	Fruit weight (g)	Fruit yield (T/ha)
1	DRD-8564	59.9	57.6	2.88	122.0	31.15
2	Advanta-1211 F <sub>1</sub>	50.2	40.6	2.80	54.0	27.90
3	Yaqui	56.9	50.0	2.64	88.0	27.85
4	Jumbo Super AB F <sub>1</sub>	52.6	43.1	3.62	57.0	26.90
5	MDS Royal Star	62.9	45.0	3.12	79.0	26.14
6	Happy Tomatay	56.2	46.2	2.74	68.0	25.98
7	MDS Red Diamond	72.3	49.4	3.18	88.0	25.11
8	Super Special AB F <sub>1</sub>	52.7	44.2	3.00	60.0	24.85
9	Advanta-1205 F <sub>1</sub>	58.3	50.6	2.90	89.0	24.69
<b>10</b>	<b>Naqeeb (Check)</b>	<b>60.2</b>	<b>49.8</b>	<b>3.26</b>	<b>81.0</b>	<b>24.63</b>
11	Ratto Tomatay	56.2	47.4	2.82	62.0	23.78
12	Cluster-809	53.0	44.9	3.14	67.0	23.21
13	Fonto	59.3	47.6	2.70	80.0	23.10
14	ICI-1201 F <sub>1</sub>	60.7	49.6	3.04	99.0	22.57
15	Red AB F <sub>1</sub>	50.2	45.7	2.76	56.0	22.09
16	MDS Santinal	60.4	50.8	2.80	92.0	21.71
17	Advanta-1209 F <sub>1</sub>	52.6	47.2	2.96	74.0	21.68
18	Taseer AB F <sub>1</sub>	54.1	48.1	2.90	72.0	21.61
19	Faris F <sub>1</sub>	49.4	45.1	3.42	59.0	21.53
20	Cluster-808	49.4	43.3	3.28	61.0	21.36
21	Nemador	53.7	46.9	3.18	72.0	20.59
22	ICI-1203 F <sub>1</sub>	64.2	46.2	2.98	86.0	20.35
<b>23</b>	<b>TAI-1757 F<sub>1</sub> (Check)</b>	<b>48.1</b>	<b>45.0</b>	<b>3.20</b>	<b>62.0</b>	<b>19.11</b>
24	Red Pearl F <sub>1</sub>	47.5	44.1	2.64	60.0	18.70
25	Wah Tomatay	58.2	45.9	2.86	70.0	18.62
26	MDS All Red	62.6	49.9	3.12	83.0	17.97
27	Laal Tomatay	48.9	42.3	2.70	60.0	17.89
28	Pound F <sub>1</sub>	61.8	51.8	2.86	96.0	17.74
29	Fast Tomatay	40.0	36.1	2.66	36.0	8.09
<b>LSD (0.05)</b>						<b>2.02</b>

The above table reveals that entries ranked from 1 – 4 produced significantly higher fruits yields than the high yielding check Naqeeb (24.63 t/ha). The entries ranked from 5 – 9 and 11 – 14 produced statistically at par fruit yields in comparison with high yielding check Naqeeb. The highest and lowest fruit yields were recorded in entries namely DRD-8564 (31.15 t/ha) and Fast Tomatay (8.09 t/ha) respectively.

**Table-9 Performance of Exotic Determinate Tomato Varieties/ Hybrids in Adaptability Trial at VRI, Faisalabad during 2015-16**  
**Set-3**

Date of nursery sowing: 03.11.2015  
Date of transplanting: 10.12.2015  
Plot size: 8.0 × 1.25 m  
Plant to plant distance: 50 cm

Rank	Variety/ Hybrid	Fruit length (mm)	Fruit width (mm)	Fruit firmness (kg/cm <sup>2</sup> )	Fruit weight (g)	Fruit yield (T/ha)
1	Rani	55.6	45.5	3.66	62.0	25.98
2	Hiker F <sub>1</sub>	60.4	46.4	4.12	76.0	25.49
3	Chaman F <sub>1</sub>	59.9	46.4	3.36	73.0	25.33
4	Solo-1	65.1	56.9	3.10	120.0	24.53
5	TM-1826	50.9	44.0	3.26	57.0	22.78
6	GSL-198	52.4	47.1	3.46	70.0	22.58
<b>7</b>	<b>Naqeeb (Check)</b>	<b>59.0</b>	<b>48.5</b>	<b>3.50</b>	<b>78.0</b>	<b>21.61</b>
8	Leader F <sub>1</sub>	53.5	45.3	3.40	74.0	21.25
9	Four Season	51.8	43.1	3.32	59.0	21.12
10	Wantia F <sub>1</sub>	60.4	53.6	2.66	102.0	20.04
11	Kanwal	57.0	47.4	3.16	79.0	19.92
12	Mehran-670	48.8	44.7	2.98	59.0	18.73
13	Shams F <sub>1</sub>	57.8	59.3	2.78	114.0	18.41
<b>14</b>	<b>TAI-1757 F<sub>1</sub> (Check)</b>	<b>47.7</b>	<b>45.0</b>	<b>3.56</b>	<b>59.0</b>	<b>18.04</b>
15	Toma-2	54.2	46.7	3.06	66.0	17.51
16	Samrudhi	53.0	48.7	3.34	73.0	17.48
17	Tomato-702	65.2	50.6	3.24	96.0	17.10
18	SV-8749 TE	48.5	43.4	3.94	53.0	16.27
19	5565 F <sub>1</sub>	51.6	43.6	3.32	56.0	16.07
20	Agata F <sub>1</sub>	62.9	49.1	3.02	75.0	15.81
21	Mart-612	50.0	43.9	3.70	59.0	15.58
22	TTM-502	53.0	47.2	2.90	66.0	15.19
23	GSL-292	53.5	47.2	3.24	71.0	13.93
24	Tejas	58.1	43.1	3.46	65.0	12.78
25	Tomato-907	61.8	51.0	3.12	90.0	12.51
26	SV-3466 TE	48.2	44.9	3.34	57.0	11.49
27	Tomato-909	59.9	51.4	3.22	94.0	7.39

28	Cosmic F <sub>1</sub>	53.6	47.2	4.04	71.0	5.62
<b>LSD (0.05)</b>						<b>3.02</b>

The above table shows that entries ranked from 1 – 3 produced significantly higher fruit yields than high yielding check Naqeeb (21.61 t/ha). However, entries ranked from 4 – 6 and 8 – 12 remained statistically at par in comparison with high yielding check Naqeeb. The highest fruit yield was depicted by the entry Rani F<sub>1</sub> (25.98 t/ha) whereas the lowest fruit yield was recorded in the entry Cosmic F<sub>1</sub> (5.62 t/ha).

**Table-10 Performance of Exotic Determinate Tomato Varieties/ Hybrids in Adaptability Trial at VRI, Faisalabad during 2015-16 (Late Received)**  
**Set-4**

Date of nursery sowing: 23.12.2015  
Date of transplanting: 22.02.2016  
Plot size: 8.0 × 1.25 m  
Plant to plant distance: 40 cm

<b>Rank</b>	<b>Variety/ Hybrid</b>	<b>Fruit yield (T/ha)</b>
1	Red Cross	2.84
2	Advanta-1247 F <sub>1</sub>	2.15
3	007	1.80
4	Supremo	1.61
5	Zamora	1.36
6	T-100	1.28
<b>7</b>	<b>Naqeeb (Check)</b>	<b>1.26</b>
8	Zermatt	1.09
9	Red Sun	1.03
10	Albi	0.95
11	Rota	0.93
12	Red Beauty	0.89
13	Capri	0.85
<b>14</b>	<b>TAI-1757 F<sub>1</sub> (Check)</b>	<b>0.83</b>
15	Euro	0.81
16	Cassandra	0.78
17	Neon	0.56
18	Rambo	0.42
19	Marina	0.38
<b>LSD (0.05)</b>		<b>0.61</b>

The above table reveals that entries ranked at No. 1 and 2 produced significantly higher fruit yields than high yielding check Naqeeb (1.26 t/ha). However, entries ranked

from 3 – 6 and 8 – 16 remained statistically at par in comparison with high yielding check Naqeeb. The highest and lowest fruit yields were recorded in the entries Red Cross (2.84 t/ha) and Marina (0.38 t/ha) respectively.

## B. INDETERMINATE TYPES

Three exotic indeterminate tomato hybrids received from different Seed Companies were tested along with two checks i.e. Sahel F<sub>1</sub> (exotic) and Salar F<sub>1</sub> (local) for their performance in adaptability trial under high tunnel at Vegetable Research Institute, Faisalabad during Rabi, 2015-16. The nursery was sown and transplanted in a Randomized Complete Block Design with three replications. The recommended agronomic and plant protection measures were adopted to maintain the crop. Data recorded for fruit length, fruit width, fruit firmness, fruit weight and fruit yield is given below.

**Table-11 Performance of Exotic Indeterminate Tomato Varieties/ Hybrids in Adaptability Trial under High Tunnel at VRI, Faisalabad during 2015-16**

Date of nursery sowing: 14.10.2015  
 Date of transplanting: 20.11.2015  
 Plot size: 3.70 × 0.85 m  
 Plant to plant distance: 40 cm

Rank	Variety/ Hybrid	Fruit length (mm)	Fruit width (mm)	Fruit firmness (kg/cm <sup>2</sup> )	Fruit weight (g)	Fruit yield (T/ha)
1	Sahel F <sub>1</sub> (Check)	55.0	46.9	3.78	83.6	101.17
2	Salar F <sub>1</sub> (Check)	56.2	45.3	3.60	70.8	100.47
3	GSL-A46	50.1	46.2	3.10	77.2	89.28
4	GHTO-01	51.3	44.5	3.48	76.4	85.38
5	CBS-A92	57.7	51.6	3.96	85.2	84.88
<b>LSD (0.05)</b>						<b>4.35</b>

The above table reveals that differences among means for fruit yield due to varieties were significant. The exotic check Sahel F<sub>1</sub> produced the maximum fruit yield of 101.17 t/ha whereas the local check Salar F<sub>1</sub> produced statistically at par fruit yield of 100.47 t/ha in comparison with the high yielding check i.e. Sahel F<sub>1</sub>. The lowest fruit yield was depicted by the entry CBS-A92 (84.88 t/ha).

## 1.8 RADP ADAPTABILITY STUDIES OF ECONOMICALLY IMPORTANT VEGETABLE LINES UNDER DIFFERENT ECOLOGICAL CONDITIONS

Five (5) determinate tomato varieties/ hybrids received from RADP Project, NARC, Islamabad were evaluated along with two checks namely TAI-1757 F<sub>1</sub> (exotic)

and Naqeeb (local) at Vegetable Research Institute, Faisalabad during Rabi, 2015-16. The nursery was sown and transplanted in a Randomized Complete Block Design with three replications. The recommended agronomic and plant protection measures were adopted to maintain the crop. Data recorded for fruit length, fruit width, fruit firmness, fruit weight and fruit yield is presented below.

**Table-12 Performance of Determinate Tomato Varieties / Hybrids in RADP Adaptability Trial at VRI, Faisalabad during 2015-16**

Date of nursery sowing: 16.10.2015  
 Date of transplanting: 08.12.2015  
 Plot size: 7.0 × 1.25 m  
 Plant to plant distance: 50 cm

Rank	Variety/ Hybrid	Fruit length (mm)	Fruit width (mm)	Fruit firmness (kg/cm <sup>2</sup> )	Fruit weight (g)	Fruit yield (T/ha)
1	Tomato-2	56.4	44.5	3.64	65.1	18.22
2	<b>Naqeeb (Check)</b>	<b>58.0</b>	<b>47.7</b>	<b>3.82</b>	<b>76.8</b>	<b>18.14</b>
3	Tomato-4	37.1	41.6	3.34	47.0	17.87
4	Tomato-1	63.3	40.6	3.24	52.6	17.33
5	Roma	64.5	43.9	3.58	61.5	15.97
6	Tomato-3	51.0	49.1	3.48	69.8	13.54
7	<b>TAI-1757 F<sub>1</sub> (Check)</b>	<b>50.2</b>	<b>46.1</b>	<b>3.76</b>	<b>66.3</b>	<b>12.86</b>
<b>LSD (0.05)</b>						<b>1.83</b>

The above table reveals that differences amongst means for fruit yield due to varieties were significant. The entries ranked at No. 1, 3 and 4 produced statistically at par fruit yields in comparison with the highest yielding check Naqeeb (18.14 t/ha). The highest fruit yield was depicted by the entry Tomato-2 (18.22 t/ha) whereas the lowest fruit yield was shown by the check entry TAI-1757 F<sub>1</sub> (12.86 t/ha).

### **1.9 NATIONAL UNIFORM YIELD TRIAL OF TOMATO VARIETIES/ HYBRIDS**

Six (6) determinate tomato varieties/ hybrids received from National Coordinator (Hort.), PARC, Islamabad were evaluated along in open field with two checks namely TAI-1757 F<sub>1</sub> (exotic) and Naqeeb (local) at Vegetable Research Institute, Faisalabad during Rabi, 2015-16. The nursery was sown and transplanted in a Randomized Complete Block Design with three replications. The recommended agronomic and plant

protection measures were adopted to maintain the crop. Data recorded for fruit length, fruit width, fruit firmness, fruit weight and fruit yield is presented below.

**Table-13 Performance of Determinate Tomato Varieties/ Hybrids in NUYT Trial at VRI, Faisalabad during 2015-16**

Date of nursery sowing: 16.10.2015  
 Date of transplanting: 08.12.2015  
 Plot size: 7.0 × 1.25 m  
 Plant to plant distance: 50 cm

Rank	Variety/ Hybrid	Fruit length (mm)	Fruit width (mm)	Fruit firmness (kg/cm <sup>2</sup> )	Fruit weight (g)	Fruit yield (t/ha)
1	TOM-15146	49.5	52.1	3.32	85.0	30.39
2	TOM-15131	55.6	53.6	3.24	97.2	23.42
<b>3</b>	<b>Naqeeb (Check)</b>	<b>59.5</b>	<b>50.5</b>	<b>4.04</b>	<b>81.2</b>	<b>23.24</b>
4	TOM-15140	47.7	51.6	3.72	81.0	22.13
5	TOM-15124	50.1	53.8	3.32	87.8	21.85
6	TOM-15101	29.9	32.5	2.96	28.6	21.34
7	TOM-15111	62.3	42.3	3.86	76.2	14.66
<b>8</b>	<b>TAI-1757 F<sub>1</sub> (Check)</b>	<b>46.6</b>	<b>42.2</b>	<b>3.96</b>	<b>59.8</b>	<b>11.90</b>
<b>LSD (0.05)</b>						<b>2.21</b>

The above table reveals that differences amongst means for fruit yield due to varieties were significant. The top ranked entry namely TOM-15146 produced significantly higher fruit yield of 30.39 t/ha whereas; entries ranked at No. 2 and 4 – 6 performed statistically at par in terms of fruit yield in comparison with highest yielding check Naqeeb (23.24 t/ha). The lowest fruit yield was depicted by the check entry TAI-1757 F<sub>1</sub> (11.90 t/ha).

#### **1.10 EVALUATION OF LOCALLY DEVELOPED DETERMINATE TOMATO ADVANCED LINES / HYBRIDS FOR AUTUMN PLANTING**

To evaluate the performance of autumn sown determinate tomato advanced lines under different ecological zones of Punjab, an experiment comprising of twelve advanced lines along with two checks namely T-1359 F<sub>1</sub> and Naqeeb was conducted at two different locations viz; VRI Faisalabad and BARI Chakwal. The details of the experiment are as under:

**Table-14 Performance of Determinate Tomato Advanced Lines in Multi-locational Trials under Walk-in Tunnel at VRI, Faisalabad and in open field at BARI, Chakwal during 2015 (Autumn Planting)**



Particulars	Faisalabad	Chakwal
Sowing date:	06.08.2015	07.07.2015
Transplanting date:	27.08.2015	20.08.2015
No. of Entries:	9	7
No. of Replications:	3	3
No. of Plants/ Entry:	10	13
Plant to plant distance:	50 cm	50 cm
Plot size:	2.5 × 2.3 m	8.0 × 1.25 m

Rank	Entry	Fruit yield (t/ha)		
		VRI, Faisalabad	BARI, Chakwal	Average
1	AUT-302	18.71	15.03	16.87
2	AUT-318	17.31	12.87	15.09
3	AUT-305	17.66	12.40	15.03
4	AUT-309	14.08	10.70	12.39
5	<b>RS-1312 F<sub>1</sub> (Check)</b>	<b>11.29</b>	-	<b>11.29</b>
6	AUT-312	13.50	7.93	10.72
7	<b>T-1359 F<sub>1</sub> (Check)</b>	<b>12.73</b>	<b>8.27</b>	<b>10.50</b>
8	AUT-315	12.54	8.07	10.31
9	<b>Kanwal F<sub>1</sub> (Check)</b>	<b>9.95</b>	-	<b>9.95</b>
<b>LSD (0.05)</b>		<b>1.92</b>	<b>1.06</b>	-

It is evident from the above table that differences among means for fruit yield due to varieties were significant at both locations. On average basis, top four advanced lines produced higher fruit yields than the highest yielding check RS-1312 F<sub>1</sub> which gave average fruit yield of 11.29 t/ha. The highest and lowest average fruit yields were depicted by the entries AUT-302 (16.87 t/ha) and Kanwal F<sub>1</sub> (9.95 t/ha) respectively.

#### 1.11 PRELIMINARY EVALUATION OF LOCALLY DEVELOPED DETERMINATE TOMATO HYBRIDS

To evaluate yield potential and other valuable characteristics of locally developed determinate tomato hybrids, an experiment comprising of 40 hybrids along with two exotic checks (T-1359 F<sub>1</sub> and TAI-1757 F<sub>1</sub>) in two sets (20 hybrids and two checks in each set) was conducted at VRI, Faisalabad during Rabi, 2015-16. The nursery was sown on 16.10.2015 and transplanted on 27.11.2015 in RCBD with two replications. Plot size was kept as 7.0 × 1.25 m and plant to plant distance was maintained at 50 cm. Data recorded for fruit length, fruit width, fruit firmness, fruit weight and fruit yield are presented in table below.

**Table-16 Performance of Locally Developed Determinate Tomato Hybrids in**

**Preliminary Yield Trial at VRI, Faisalabad during 2015-16 (Set-1)**

Rank	Entry	Fruit length (mm)	Fruit width (mm)	Fruit firmness (kg/cm <sup>2</sup> )	Fruit weight (g)	Fruit yield (t/ha)
1	LTH-375	46.0	50.9	3.28	76.6	33.78
2	LTH-373	49.3	52.6	3.02	82.8	32.82
3	LTH-376	49.3	51.7	3.44	83.6	31.39
4	LTH-369	50.0	51.5	3.00	78.0	30.61
5	LTH-377	51.2	56.7	3.42	94.4	29.31
6	LTH-366	62.0	44.1	4.44	72.4	27.08
7	LTH-367	44.7	38.7	3.42	42.8	26.09
8	LTH-371	59.9	46.9	4.70	74.0	25.37
<b>9</b>	<b>T-1359 F<sub>1</sub> (Check)</b>	<b>49.2</b>	<b>44.2</b>	<b>4.24</b>	<b>66.4</b>	<b>24.92</b>
10	LTH-363	39.2	47.0	3.58	57.6	24.65
11	LTH-365	53.0	46.0	4.04	73.8	23.28
12	LTH-378	47.5	50.8	3.80	81.2	22.26
13	LTH-382	42.3	43.2	3.66	56.8	21.82
14	LTH-370	58.8	44.6	3.86	69.4	21.60
15	LTH-379	47.9	53.4	3.92	82.8	20.49
16	LTH-364	55.8	48.0	4.54	79.4	19.55
17	LTH-372	51.1	49.6	3.78	76.4	19.28
18	LTH-380	39.6	41.0	3.46	59.4	18.66
19	LTH-384	54.2	44.8	4.06	65.8	18.31
20	LTH-381	44.1	40.0	3.20	51.8	15.90
<b>21</b>	<b>TAI-1757 F<sub>1</sub> (Check)</b>	<b>50.6</b>	<b>46.0</b>	<b>3.96</b>	<b>64.6</b>	<b>15.67</b>
22	LTH-368	44.3	41.9	2.72	57.2	12.94
<b>LSD (0.05)</b>						<b>2.43</b>

The above table reveals that differences among means for fruit yield due to genotypes were significant. The hybrid entries ranked from 1 – 5 produced significantly higher fruit yields than the better check T-1359 F<sub>1</sub> which gave the fruit yield of 24.92 t/ha. The entries ranked from No. 6 – 8 and 10 – 11 performed statistically at par in terms of fruit yields in comparison with the highest yielding check T-1359 F<sub>1</sub>. The highest fruit yield was produced by the entry LTH-375 (33.78 t/ha) whereas; the lowest fruit yield was depicted by the entry LTH-368 (12.94 t/ha).

**Table-17 Performance of Locally Developed Determinate Tomato Hybrids in Preliminary Yield Trial at VRI, Faisalabad during 2015-16 (Set-2)**

Rank	Entry	Fruit length (mm)	Fruit width (mm)	Fruit firmness (kg/cm <sup>2</sup> )	Fruit weight (g)	Fruit yield (t/ha)
1	LTH-409	31.4	38.0	3.52	40.6	31.34

2	LTH-408	47.8	46.6	3.36	70.6	27.58
3	LTH-397	47.9	49.6	3.14	77.0	27.22
4	LTH-395	42.9	44.5	3.34	56.6	26.63
5	LTH-403	48.4	41.4	3.20	55.8	25.17
6	LTH-399	45.0	47.8	3.50	72.0	24.13
7	LTH-398	51.5	52.5	3.46	90.2	22.54
8	LTH-404	45.6	44.7	3.34	60.2	22.33
<b>9</b>	<b>T-1359 F<sub>1</sub> (Check)</b>	<b>49.6</b>	<b>43.0</b>	<b>3.92</b>	<b>64.4</b>	<b>21.36</b>
10	LTH-405	56.0	47.9	3.54	76.8	21.01
11	LTH-386	43.6	43.0	3.00	55.4	20.89
12	LTH-389	50.7	42.7	3.30	63.8	20.47
13	LTH-385	43.9	38.4	3.94	44.2	20.06
14	LTH-394	45.5	38.8	3.32	45.8	19.66
15	LTH-387	40.5	34.1	3.64	34.0	19.55
16	LTH-391	45.9	38.6	4.06	38.0	18.82
17	LTH-400	43.5	38.8	3.66	45.6	16.07
<b>18</b>	<b>TAI-1757 F<sub>1</sub> (Check)</b>	<b>48.3</b>	<b>43.1</b>	<b>3.76</b>	<b>62.6</b>	<b>16.05</b>
19	LTH-401	43.4	37.7	3.30	44.4	15.79
20	LTH-390	29.3	29.8	2.96	32.4	14.94
21	LTH-388	42.9	41.5	3.76	54.6	14.67
22	LTH-393	23.6	23.7	3.06	20.4	13.88
<b>LSD (0.05)</b>						<b>2.22</b>

The above table reveals that differences among means for fruit yield due to genotypes were significant. The entries ranked from No. 1 – 6 showed statistically significant performance in terms of fruit yields as compared with the higher check T-1359 F<sub>1</sub> (21.36 t/ha). However, the entries ranked from No. 7 – 8 and 10 – 15 showed statistically at par fruit yields as compared with the higher check T-1359 F<sub>1</sub>. The highest and lowest fruit yields were depicted by the entries LTH-409 (31.34 t/ha) and LTH-393 (13.88 t/ha) respectively.

#### **1.12 SECONDARY/ STATION YIELD EVALUATION OF LOCALLY DEVELOPED DETERMINATE TOMATO HYBRIDS**

An experiment comprising of seven (7) determinate tomato hybrids along with two exotic checks namely T-1359 F<sub>1</sub> and TAI-1757 F<sub>1</sub> was conducted at VRI, Faisalabad to evaluate the yield potential and other valuable characteristics. The nursery was sown on 16.10.2015 and transplanted on 27.11.2015 in RCBD with three replications. Plot size was kept as 7.0 × 1.25 m and plant to plant distance was maintained at 50 cm. Data

recorded for fruit length, fruit width, fruit firmness, fruit weight and fruit yield are presented in table below.

**Table-18 Performance of Locally Developed Determinate Tomato Hybrids in Secondary/ Station Yield Trial at VRI, Faisalabad during 2015-16**

Rank	Entry	Fruit length (mm)	Fruit width (mm)	Fruit firmness (kg/cm <sup>2</sup> )	Fruit weight (g)	Fruit yield (t/ha)
1	LTH-324	46.4	50.4	3.62	79.4	30.53
2	LTH-361	49.3	50.4	3.82	69.2	26.91
3	LTH-291	51.1	53.4	3.94	84.0	24.02
4	LTH-350	55.4	52.1	3.46	97.2	23.81
5	LTH-315	50.1	45.5	4.02	66.4	22.17
6	LTH-359	49.5	45.2	3.92	74.6	21.67
7	<b>T-1359 F<sub>1</sub> (Check)</b>	<b>48.6</b>	<b>42.6</b>	<b>4.28</b>	<b>63.6</b>	<b>20.43</b>
8	<b>TAI-1757 F<sub>1</sub> (Check)</b>	<b>48.1</b>	<b>42.4</b>	<b>4.10</b>	<b>60.2</b>	<b>15.22</b>
9	LTH-332	50.0	45.3	4.30	70.8	15.06
<b>LSD (0.05)</b>						<b>1.95</b>

The above table reveals that differences among means for fruit yield due to genotypes were significant. The hybrid entries ranked at No. 1 – 4 produced statistically significant fruit yields against the higher check T-1359 F<sub>1</sub> (20.43 t/ha). Whereas; the entries ranked from 5 – 6 remained statistically at par in terms of fruit yields as compared with the higher check T-1359 F<sub>1</sub>. The highest fruit was produced by the entry LTH-324 (30.53 t/ha) and lowest fruit yield was depicted by the entry LTH-332 (15.06 t/ha).

### 1.13 MULTI-LOCATIONAL / ZONAL TESTING OF LOCALLY DEVELOPED DETERMINATE TOMATO HYBRIDS

A trial comprising of eight (8) locally developed determinate tomato hybrids along with two exotic checks i.e. T-1359 F<sub>1</sub> and TAI-1757 F<sub>1</sub> was planted to evaluate the performance at four different locations viz; VRI Faisalabad, VRSS Sheikhpura, VRSS Multan and RARI Bahawalpur. The nursery of these hybrids was sown on 16.10.2015 and transplanting was done according to RCBD in 3 replications. The plant to plant distance was kept as 50 cm. The fruit yield data recorded at different locations is given below in table.

Location	Transplantation Date	Plot Size
VRI, Faisalabad	27.11.2015	7.0 × 1.25 m
VRSS, Sheikhpura	24.11.2015	7.0 × 1.25 m
VRSS, Multan	01.12.2015	7.0 × 1.25 m

RARI, Bahawalpur	02.12.2015	7.0 × 1.25 m
------------------	------------	--------------

**Table-19 Performance of Determinate Tomato Hybrids in Multi-locational / Zonal Trial at VRI, Faisalabad during 2015-16**

Rank	Entry	Fruit length (mm)	Fruit width (mm)	Fruit firmness (kg/cm <sup>2</sup> )	Fruit weight (g)	Fruit yield (T/ha)
1	NBH-2	48.0	52.2	3.18	79.8	36.41
2	NBH-25	48.0	47.7	2.74	67.2	35.56
3	NBH-3	47.5	52.9	3.34	84.2	33.73
4	LTH-297	44.4	41.1	3.72	62.6	33.18
5	NBH-7	45.6	49.9	2.86	68.6	32.23
6	Ahmar F <sub>1</sub>	52.1	45.2	3.88	70.8	26.65
7	LTH-287	49.1	46.7	3.28	75.2	26.16
<b>8</b>	<b>T-1359 F<sub>1</sub> (Check)</b>	<b>48.9</b>	<b>42.7</b>	<b>3.94</b>	<b>69.2</b>	<b>23.12</b>
9	LTH-252	48.2	42.4	3.72	73.4	20.70
<b>10</b>	<b>TAI-1757 F<sub>1</sub> (Check)</b>	<b>48.7</b>	<b>45.5</b>	<b>3.88</b>	<b>61.0</b>	<b>17.50</b>
<b>LSD (0.05)</b>						<b>1.74</b>

The above table reveals that differences among means for fruit yield due to genotypes were significant. The hybrid entries ranked from 1 – 6 produced significantly higher fruit yields as compared with the highest yielding check T-1359 F<sub>1</sub> (23.12 t/ha). The highest fruit yield was depicted by NBH-2 (36.41 t/ha) whereas the lowest fruit yield was given by the check entry TAI-1757 F<sub>1</sub> (17.50 t/ha).

**Table-20 Performance of Determinate Tomato Hybrids in Multi-locational / Zonal Trials at Different Locations during 2015-16**

Rank	Entry	Fruit yield (T/ha)				
		FSD	S. Pura	Multan	B. Pur	Average
1	NBH-2	36.41	32.55	30.93	-	33.30
2	NBH-25	35.56	28.63	28.42	-	30.87
3	NBH-3	33.73	30.82	27.12	-	30.56
4	NBH-7	32.23	26.63	25.98	-	28.28
5	LTH-297	33.18	29.87	27.64	22.17	28.22
6	Ahmar F <sub>1</sub>	26.65	24.80	23.94	18.90	23.57
7	LTH-287	26.16	24.72	22.88	19.60	23.34
<b>8</b>	<b>T-1359 F<sub>1</sub> (Check)</b>	<b>23.12</b>	<b>22.90</b>	<b>23.31</b>	<b>17.47</b>	<b>21.70</b>
9	LTH-252	20.70	19.01	18.61	15.62	18.49
<b>10</b>	<b>TAI-1757 F<sub>1</sub> (Check)</b>	<b>17.50</b>	<b>16.90</b>	<b>15.89</b>	<b>12.95</b>	<b>15.81</b>
<b>LSD (0.05)</b>		<b>1.74</b>	<b>2.23</b>	<b>1.89</b>	<b>2.37</b>	<b>-</b>

It is evident from the above table that differences amongst means for fruit yield due to varieties were significant at all locations. On average basis, entries ranked from No. 1 – 7 produced higher fruit yields than the highest yielding check T-1359 F<sub>1</sub> which gave average fruit yield of 21.70 t/ha. The highest average fruit yield was depicted by the hybrid namely NBH-2 (33.30 t/ha) whereas; the lowest average fruit yield of 15.81 t/ha was recorded in check entry TAI-1757 F<sub>1</sub>.

#### 1.14 COMPARISON OF FRUIT YIELDS OF DETERMINATE TOMATO HYBRID AHMAR F<sub>1</sub> (LTH-169) AND EXOTIC HYBRID T-1359 F<sub>1</sub> IN TERMS OF EARLINESS IN FRUIT SETTING

A trial comprising of one locally developed determinate tomato hybrid Ahmar F<sub>1</sub> and one exotic hybrid T-1359 F<sub>1</sub> was planted to evaluate the yield performance in terms of earliness in fruit setting at VRI Faisalabad. Planting was done as per following details:

Nursery sowing date:	16.10.2015
Transplanting:	30.11.2015
Plot size:	14.0 × 1.0 m (Ahmar F <sub>1</sub> )
	14.0 × 1.25 m (T-1359 F <sub>1</sub> )
Plant to plant distance:	40 cm (Ahmar F <sub>1</sub> )
	50 cm (T-1359 F <sub>1</sub> )
No. of replications:	3

The fruit yield data of both the hybrids was recorded on same picking dates as detailed below:

**Table-21 Comparison of Ahmar F<sub>1</sub> (LTH-169) and T-1359 F<sub>1</sub> in a Trial at VRI, Faisalabad during 2015-16**

Rank	Name of Entry	Fruit yield on different picking dates (T/ha)						Total
		30.03.16	12.04.16	22.04.16	02.05.16	13.05.16	23.05.16	
1	Ahmar F <sub>1</sub> (LTH-169)	1.73	3.55	6.56	6.00	5.82	3.35	27.01
2	T-1359 F <sub>1</sub>	0.02	1.02	3.55	5.73	5.96	4.09	20.37
<b>LSD (0.05)</b>								<b>2.18</b>

The above table reveals that differences among means for fruit yield due to genotypes were significant. The locally developed hybrid Ahmar F<sub>1</sub> produced significantly higher fruit yield (27.01 t/ha) in comparison with the exotic hybrid T-1359 F<sub>1</sub> (20.37 t/ha). Moreover, Ahmar F<sub>1</sub> started producing fruits earlier than exotic check and remained at top at four initial picking dates out of six total pickings.

### 1.15 PRELIMINARY EVALUATION OF LOCALLY DEVELOPED INDETERMINATE TOMATO HYBRIDS

A varietal trial comprising of 42 hybrids along with one exotic check i.e. Sahel F<sub>1</sub> was planted in three sets (14 hybrids and one check in each set) to evaluate the performance of locally developed indeterminate tomato hybrids. Nursery was sown on 28.10.2015 and transplanted on 04.12.2015 in Randomized Complete Block Design with two replications under high tunnel. The plot size was kept as 3.70 × 0.85 m while, plant to plant spacing was maintained at 40 cm. Fruit picking was started on 17.03.2016 and continued till 06.06.2016 with total number of twelve pickings. The data recorded for fruit length, fruit width, fruit firmness, fruit weight and fruit yield is presented in table below.

**Table-22 Performance of Locally Developed Indeterminate Tomato Hybrids under High Tunnel in Preliminary Yield Trial at VRI, Faisalabad during 2015-16 (Set-1)**

Rank	Entry	Fruit length (mm)	Fruit width (mm)	Fruit firmness (kg/cm <sup>2</sup> )	Fruit weight (g)	Fruit yield (t/ha)
1	LITTH-779	50.9	49.5	3.70	81.2	93.41
2	LITTH-789	51.6	45.6	3.98	61.8	93.11
3	LITTH-778	56.3	53.8	3.64	105.4	92.47
<b>4</b>	<b>Sahel F<sub>1</sub> (Check)</b>	<b>62.7</b>	<b>53.7</b>	<b>3.98</b>	<b>94.6</b>	<b>90.61</b>
5	LITTH-780	55.6	42.3	3.50	64.1	90.22
6	LITTH-784	46.9	39.4	3.32	48.6	86.67
7	LITTH-783	57.8	41.7	3.20	62.4	82.89
8	LITTH-786	48.1	44.5	3.14	57.6	81.72
9	LITTH-790	56.2	43.2	4.14	63.8	79.62
10	LITTH-785	50.9	43.5	4.34	59.8	77.78
11	LITTH-788	47.0	39.7	3.18	52.4	74.52
12	LITTH-782	45.2	44.9	3.06	57.4	69.53
13	LITTH-787	45.7	40.6	3.10	49.4	69.38
14	LITTH-793	58.6	49.8	3.22	90.0	68.82
15	LITTH-781	45.3	41.7	3.02	49.2	53.07
<b>LSD (0.05)</b>						<b>6.09</b>

The perusal of the table indicates that differences among means for fruit yield due to genotypes were significant. The hybrid entries ranked from No. 1 – 3 and 5 – 6 produced statistically at par fruit yields as compared with the exotic check Sahel F<sub>1</sub> (90.61 t/ha). The hybrid entry LITTH-779 (93.41 t/ha) produced highest fruit yield whereas the lowest fruit yield was depicted by the entry LITTH-781 (53.07 t/ha).

**Table-23 Performance of Locally Developed Indeterminate Tomato Hybrids under High Tunnel in Preliminary Yield Trial at VRI, Faisalabad during 2015-16 (Set-2)**

Rank	Entry	Fruit length (mm)	Fruit width (mm)	Fruit firmness (kg/cm <sup>2</sup> )	Fruit weight (g)	Fruit yield (t/ha)
1	LITTH-799	60.0	44.7	3.64	75.2	93.23
2	LITTH-807	44.5	44.2	4.06	59.2	92.02
<b>3</b>	<b>Sahel F<sub>1</sub> (Check)</b>	<b>62.9</b>	<b>53.7</b>	<b>3.80</b>	<b>97.4</b>	<b>90.74</b>
4	LITTH-809	62.2	40.6	4.74	64.8	85.40
5	LITTH-810	61.7	51.3	3.92	70.0	83.98
6	LITTH-801	60.8	50.1	3.06	69.0	82.27
7	LITTH-794	44.9	42.8	3.42	55.4	79.51
8	LITTH-808	44.9	44.2	2.98	54.0	78.39
9	LITTH-796	71.4	49.7	3.46	99.6	77.53
10	LITTH-806	62.0	44.7	3.72	63.0	76.41
11	LITTH-797	51.6	48.0	3.74	73.0	73.85
12	LITTH-798	51.7	41.2	4.10	58.2	73.83
13	LITTH-804	52.9	43.6	3.02	78.6	72.84
14	LITTH-803	42.8	43.3	3.08	74.2	69.79
15	LITTH-795	48.7	50.8	3.28	85.8	68.39
<b>LSD (0.05)</b>						<b>4.83</b>

The perusal of table indicates that differences among means for fruit yield due to genotypes were significant. Two top ranked entries namely LITTH-799 (93.23 t/ha) and LITTH-807 (92.02 t/ha) produced statistically at par fruit yields in comparison with the exotic check Sahel F<sub>1</sub> (90.74 t/ha). The lowest fruit yield was recorded in hybrid entry LITTH-795 (68.39 t/ha).

**Table-24 Performance of Locally Developed Indeterminate Tomato Hybrids under High Tunnel in Preliminary Yield Trial at VRI, Faisalabad during 2015-16 (Set-3)**

Rank	Entry	Fruit length (mm)	Fruit width (mm)	Fruit firmness (kg/cm <sup>2</sup> )	Fruit weight (g)	Fruit yield (t/ha)
1	LITTH-818	50.5	49.6	3.66	80.6	100.37
2	LITTH-816	45.5	45.2	3.18	60.8	98.33
<b>3</b>	<b>Sahel F<sub>1</sub> (Check)</b>	<b>63.5</b>	<b>53.1</b>	<b>3.86</b>	<b>92.6</b>	<b>92.90</b>
4	LITTH-823	47.1	50.1	3.32	80.4	91.52
5	LITTH-811	60.2	47.0	3.58	98.2	87.48
6	LITTH-815	60.2	37.0	3.40	53.2	83.95
7	LITTH-827	40.1	41.5	3.12	42.4	83.50
8	LITTH-822	39.6	39.6	3.16	47.0	81.19
9	LITTH-819	50.6	46.5	3.44	68.4	80.65
10	LITTH-813	51.9	41.6	3.14	54.6	80.07



11	LITTH-826	41.7	38.5	3.32	42.0	79.83
12	LITTH-825	54.7	36.5	3.98	48.6	76.78
13	LITTH-814	54.3	39.0	3.46	54.0	73.24
14	LITTH-828	34.6	38.8	3.00	39.8	66.64
15	LITTH-824	53.4	51.7	3.12	91.2	65.00
<b>LSD (0.05)</b>						<b>6.19</b>

The perusal of table indicates that differences among means for fruit yield due to genotypes were significant. The top ranked entry LITTH-818 (100.37 t/ha) produced significantly higher fruit yield than the exotic check Sahel F<sub>1</sub> (92.90 t/ha). The entries ranked at No. 2, 4 and 5 remain statistically at par in terms of fruit yield as compared with the exotic check Sahel F<sub>1</sub>. The lowest fruit yield of 65.00 t/ha was depicted by the hybrid entry namely LITTH-824.

#### **1.16 SECONDARY / STATION YIELD EVALUATION OF LOCALLY DEVELOPED INDETERMINATE TOMATO HYBRIDS**

To evaluate the performance of promising locally developed indeterminate F<sub>1</sub> tomato hybrids, a trial comprising of seven (7) locally developed hybrids along with three checks (2 exotic and 1 local) was planted at VRI, Faisalabad under high tunnel. The nursery was sown on 28.10.2015 and transplanted on 04.12.2015 in Randomized Complete Block Design with three replications under high tunnel. The plot size was kept as 3.70 × 1.70 m while, plant to plant spacing was maintained as 40 cm. Fruit picking was started on 29.03.2016 and continued till 06.06.2016 with total number of eleven pickings. The data recorded for fruit length, fruit width, fruit firmness, fruit weight and fruit yield are presented in table below.

**Table-25 Performance of Indeterminate Tomato Hybrids under High Tunnel in Secondary / Station Yield Trial at VRI, Faisalabad during 2015-16**

<b>Rank</b>	<b>Entry</b>	<b>Fruit length (mm)</b>	<b>Fruit width (mm)</b>	<b>Fruit firmness (kg/cm<sup>2</sup>)</b>	<b>Fruit weight (g)</b>	<b>Fruit yield (t/ha)</b>
1	LITTH-707	54.4	52.0	4.12	87.0	88.16
2	LITTH-765	63.6	53.1	4.18	98.0	88.02
<b>3</b>	<b>Sahel F<sub>1</sub> (Check)</b>	<b>63.3</b>	<b>54.5</b>	<b>4.02</b>	<b>95.0</b>	<b>87.94</b>
<b>4</b>	<b>Anna F<sub>1</sub> (Check)</b>	<b>54.7</b>	<b>47.7</b>	<b>4.20</b>	<b>78.4</b>	<b>86.18</b>
<b>5</b>	<b>Saandal F<sub>1</sub> (Check)</b>	<b>58.9</b>	<b>52.7</b>	<b>4.06</b>	<b>91.2</b>	<b>84.54</b>
6	LITTH-757	52.8	48.0	4.28	65.0	82.28
7	LITTH-764	57.4	47.6	4.24	63.2	79.49
8	LITTH-776	52.3	48.0	3.92	67.6	78.71

9	LITTH-682	55.5	47.3	3.50	74.4	73.09
10	LITTH-738	50.6	53.3	3.82	80.4	71.50
<b>LSD (0.05)</b>						<b>4.46</b>

The above table reveals that differences among means for fruit yield due to varieties were significant. Two top ranked entries namely LITTH-707 (88.16 t/ha) and LITTH-765 (88.02 t/ha) produced statistically at par fruit yields than the high yielding exotic check Sahel F<sub>1</sub> (87.94 t/ha). The lowest fruit yield of 71.50 t/ha was depicted by the hybrid entry LITTH-738.

### 1.17 MULTI-LOCATIONAL / ZONAL TESTING OF LOCALLY DEVELOPED INDETERMINATE TOMATO HYBRIDS

A trial comprising of five (5) locally developed indeterminate F<sub>1</sub> tomato hybrids along with three checks namely Sahel F<sub>1</sub> (exotic), Anna F<sub>1</sub> (exotic) and Salar F<sub>1</sub> (local) was planted to evaluate the performance at four different locations viz; VRI Faisalabad, VRSS Sheikhpura, VRSS Multan and BARI Chakwal. The nursery of these hybrids was sown on 14.10.2015. Transplanting of the nursery was done according to RCBD in 3 replications and plant to plant distance was kept as 40 cm. The data for fruit length, fruit width, fruit firmness, fruit weight and fruit yield was recorded at Faisalabad location while at the rest of locations only fruit yield data was recorded. The detail is presented below in tables.

Location	Transplantation Date	Plot Size
VRI, Faisalabad	17.11.2015	3.70 × 1.70 m
VRSS, Sheikhpura	24.11.2015	2.80 × 0.85 m
VRSS, Multan	01.12.2015	2.80 × 0.85 m
BARI, Chakwal	11.11.2015	9.50 × 0.75 m

**Table-26 Performance of Indeterminate Tomato Hybrids under High Tunnel in Multi-locational / Zonal Trial at VRI, Faisalabad during 2015-16**

Rank	Entry	Fruit length (mm)	Fruit width (mm)	Fruit firmness (kg/cm <sup>2</sup> )	Fruit weight (g)	Fruit yield (t/ha)
1	<b>Salar F<sub>1</sub> (Check)</b>	<b>57.4</b>	<b>47.0</b>	<b>3.76</b>	<b>74.8</b>	<b>104.43</b>
2	LITTH-691	66.3	46.5	3.80	81.7	103.18
3	LITTH-710	53.8	50.3	3.98	78.3	102.36
4	<b>Sahel F<sub>1</sub> (Check)</b>	<b>62.7</b>	<b>52.2</b>	<b>3.84</b>	<b>96.1</b>	<b>100.38</b>
5	LITTH-682	55.6	48.1	3.30	84.2	99.80
6	<b>Anna F<sub>1</sub> (Check)</b>	<b>57.2</b>	<b>49.2</b>	<b>4.06</b>	<b>83.5</b>	<b>96.11</b>

7	LITTH-714	61.8	48.8	3.90	80.5	92.45
8	LITTH-611	56.2	46.2	3.72	75.6	90.74
<b>LSD (0.05)</b>						<b>4.20</b>

The above table reveals that differences among means for fruit yield due to varieties were significant. The entries ranked at No. 2 and 3 produced statistically at par fruit yields than the highest yielding check Salar F<sub>1</sub> (104.43 t/ha) which is also the No. 1 ranked entry. The lowest fruit yield of 90.74 t/ha was recorded in entry LITTH-611.

**Table-27 Performance of Indeterminate Tomato Hybrids under Tunnels at Different Locations in Multi-locational / Zonal Trial during 2015-16**

Rank	Entry	Fruit yield (T/ha)				
		FSD	S. Pura	Multan	Chakwal	Average
<b>1</b>	<b>Salar F<sub>1</sub> (Check)</b>	<b>104.43</b>	<b>103.64</b>	<b>99.86</b>	<b>-</b>	<b>102.64</b>
2	LITTH-691	103.18	101.96	98.11	97.87	100.28
3	LITTH-710	102.36	97.90	96.64	88.01	96.23
<b>4</b>	<b>Sahel F<sub>1</sub> (Check)</b>	<b>100.38</b>	<b>98.74</b>	<b>96.85</b>	<b>87.68</b>	<b>95.91</b>
<b>5</b>	<b>Anna F<sub>1</sub> (Check)</b>	<b>96.11</b>	<b>94.68</b>	<b>93.91</b>	<b>-</b>	<b>94.90</b>
6	LITTH-682	99.80	96.92	94.96	77.47	92.29
7	LITTH-611	90.74	93.14	89.71	85.73	89.83
8	LITTH-714	92.45	91.81	90.76	78.39	88.35
<b>LSD (0.05)</b>		<b>4.20</b>	<b>6.80</b>	<b>7.18</b>	<b>6.78</b>	<b>-</b>

It is evident from the above table that differences among means for fruit yield due to varieties were significant at all locations. However on average basis, none of the entries produced higher fruit yields than the high yielding check Salar F<sub>1</sub> (102.64 t/ha) which is also the top ranked entry. The lowest fruit yield of 88.35 t/ha was recorded in hybrid namely LITTH-714.

## **2. PEAS (*Pisum sativum*)**

### **2.1 COLLECTION, EVALUATION AND MAINTENANCE OF GERMPLASM**

A total of seventy five varieties/lines comprising of local and exotic were sown on 11-11-15 in observational trial having a plot size of 5.0 × 1.25 m<sup>2</sup> for their maintenance. Range for different characters in available germplasm is presented in the Table.

**Table-28 Range of Different Morphological Traits in Peas local/exotic lines planted at Vegetable Research Institute, Faisalabad.**

S. No	Traits	Minimum	Maximum
1.	Days to 50 % Flowering	29	86
2.	No. of Seeds/pod	5	8
3.	Pod Length (cm)	6	11
4.	Pod Width (cm)	1.4	2.0
5.	Plant Height (cm)	39	110
6.	Fresh 100- Seed Weight (g)	14	74

## 2.2 HYBRIDIZATION AND STUDY OF FILIALS

### 2.2.1 Hybridization

To develop high yielding and early maturing varieties in peas, three cross combinations were made. The early maturing genotype i.e. 9374 was crossed with high yielding lines i.e. Meteor Lina Pak and 1300-8. Hundred flowers of each genotype were emasculated and crossed with the pollen of desired parents. The seed of three cross combinations were harvested and threshed separately for further studies in F<sub>1</sub> generation. The success rate was about 55%.

### 2.2.2 Study of Filials

Following filial generations were studied and high yielding, early bearing and disease tolerant/resistant plants were selected in different generations. The detail is given as below:

GENERATION	CROSS	# of crosses/progenies	
		STUDIED	SELECTED
F <sub>1</sub>	9374 × 2001-40	2	Selected as bulk and selfed plants were rogued out
	Meteor × 2001-40		
F <sub>2</sub>	9800-10 × 2001-40	110	14
	2001-20 × 2001-40	150	29
	Lina pak × 2001-40	175	18
F <sub>3</sub>	9375 × 2001-40	140	12
	Pea-2009 × 2001-40	75	8
	9200-1 × 2001-40	100	10
	9375 × 9374	87	10
F <sub>4</sub>	9200-1 × 2001-60	145	14
F <sub>5</sub>	Pea-09 × 2001-60	155	13
	9800-10 × 2001-60	250	19
	Meteor Fsd × 2001-60	170	11

F <sub>6</sub>	2001-20 × It-96	300	52
	9200-1 × No. 267	140	11
	2001-35 × No. 267	150	19
F <sub>7</sub>	GRW-45 × It-96	27	19
	9800-5 × No. 267	25	14
	PF-400 × No. 267	15	5

#### **2.2.2.1 Study of F<sub>1</sub> Generation**

Two crosses i.e. 9374 × 2001-40 and meteor × 2001-40 were sown along with parents on both sides of one meter wide beds to raise F<sub>1</sub> generation. Selfed plants of crosses were rouged out at different plant growth stages. At maturity, ensured seed of cross combination was harvested in bulk separately.

#### **2.2.2.2 F<sub>2</sub> Generation**

One hundred and ten seeds of 9800-10 × 2001-40, One hundred and fifty seeds 2001-20 × 2001-40 and one seventy five seeds of Lina pak × 2001-40 were sown on both sides of 6 meter long raised beds. Fourteen, twenty nine and eighteen single plants were selected from each cross respectively and bulked separately on the basis of desirable traits like yield contributing traits (number of pods, pod bearing and pod size), disease resistance/tolerance and earliness for further studies in the subsequent F<sub>3</sub> generation.

#### **2.2.2.3 F<sub>3</sub> Generation**

One hundred and forty five seeds of 9375 × 2001-40, seventy five seeds of Pea-2009 × 2001-40, one hundred seeds of 9200-1 × 2001-40 and eighty seven seeds of 9375 × 9374 were sown on both sides of 6 m long beds. Twelve ,eight, ten and ten single plants were selected from each cross respectively and bulked separately on the basis of desirable traits like yield contributing traits (number of pods, pod bearing and pod size), disease resistance/tolerance and earliness for further studies in the subsequent F<sub>4</sub> generation.

#### **2.2.2.4 F<sub>4</sub> Generation**

One hundred and forty five seeds of 9200-1 × 2001-60 were sown on both sides of 6 m long beds. Fourteen single plants were selected from respective cross and bulk on the basis of desirable traits like yield contributing traits (number of pods, pod bearing and pod size), disease resistance/tolerance and earliness for further studies in the subsequent F<sub>5</sub> generation.

### 2.2.2.5 F<sub>5</sub> Generation

One hundred and fifty five seeds of Pea-09 × 2001-60, Two hundred and fifty seeds of 9800-10 × 2001-60, One hundred and seventy seeds of Meteor Fsd × 2001-60 were sown on both sides of 6 m long beds. Thirteen, nineteen and eleven single plants were selected respectively from each cross respectively and bulked the seed of selected plants on the basis of early/late maturity, yield contributing traits (number of pods, pod size and good pod bearing), earliness and disease resistance/tolerance for further studies in F<sub>6</sub> generation.

### 2.2.2.6 F<sub>6</sub> Generation

Three hundred seeds of 2001-20 × It-96, One hundred and forty seeds of 9200-1 × No. 267 and one fifty seeds of 2001-35 × No. 267 were planted and fifty two, eleven and nineteen single plants were selected respectively on the basis of good bearing and disease tolerance and earliness for growing plant to row progenies in next generation.

### 2.2.2.7 F<sub>7</sub> Generation

Twenty seven plant to row progenies of cross GRW-45 × It-96, twenty five of 9800-5 × No. 267, fifteen plant to row progenies of cross PF-400 × No. 267 were planted and nineteen, fourteen and five progenies of three crosses were selected respectively on the basis of good bearing and disease tolerance and earliness for checking their potential in preliminary yield trail.

## 2.3 EVALUATION OF PEA VARIETIES/ADVANCE LINES FOR EARLY PLANTING

Ten varieties/lines of peas were planted on 13-10-15 at Faisalabad to study the performance of early pea varieties/advance lines. The layout was conducted according to Randomized Complete Block Design with three replications in a plot size of 5.0 × 1.5 m. Plant to plant and row to row distances were kept as 5 cm and 75cm, respectively. The data on different traits were recorded and is presented in the Table.

**Table-29 Performance of Pea Strains/Varieties in Early Peas Varietal Trial at Vegetable Research Institute, Faisalabad during 2015-16**

S. No.	Variety/ Line	Days to 50 % flowering	Plant Height (cm)	No. of pods/plant	Seeds/pod	100-Seed Weight (g) Fresh	Green Pod Yield (t/ha)
--------	---------------	------------------------	-------------------	-------------------	-----------	---------------------------	------------------------

1	<b>Pea-2009 (C)</b>	29.00	57.22	7.60	7.66	74.07	8.44
2	1300-8	31.00	51.24	15.33	7.93	55.03	7.78
3	Sarsabz	31.00	58.55	8.86	7.40	61.33	7.32
4	9375	52.67	99.00	12.80	7.33	51.62	7.22
5	2001-20	30.67	82.44	11.06	7.46	42.93	6.90
6	2001-40	30.67	79.66	9.00	6.13	54.27	6.90
7	9800-5	30.67	56.11	9.73	7.06	43.33	6.46
8	9200-1	30.67	56.55	8.26	6.73	50.67	6.20
9	<b>Meteor (C)</b>	31.33	57.53	9.80	7.13	41.10	5.69
10	Strike	27.00	39.00	4.66	4.93	52.00	4.09
<b>LSD (0.05)</b>		<b>0.71</b>	<b>6.15</b>	<b>1.27</b>	<b>0.45</b>	<b>3.19</b>	<b>0.62</b>

Differences of means due to genotypes were significant for all studied traits. Maximum green pod yield of (8.44 t/ha) was recorded for the check variety Pea-2009 which is statistically significant with all other varieties. Advance line 1300-8 produced yield (7.78 t/ha) which is at par with the strains Sarsabz and 9375 respectively. The strain Strike took minimum days to 50% flower (27.00days) which is statistically significant with all other lines.

Highest fresh 100-seed weight of 74.07g was recorded for check variety Pea-2009 followed by approved variety Sarsabz with fresh 100-seed weight 61.33g which are statistically significant with each other and all other high yielding lines. Maximum plant height was observed for line 9375 (99.00 cm) followed by 82.44 recorded in line 2001-20. Maximum number of pods per plant was recorded in line 1300-8 (15.33 pods/plant) as compared with all other lines including checks.

### **Observations**

It is observed that line 1300-8 produced first pick as early as strike so it could be a promising line with early maturing and high yielding traits.

### **2.4 EVALUATION OF PEA VARIETIES/LINES FOR NORMAL PLANTING.**

Twelve varieties/lines including two checks were sown on 11-11-2015 to test their performance in normal planting time for green pod yield. The experiment was designed according to Randomized Complete Block Design with three replications. The plot size of the experiment was kept as 4.0 × 2.0 m<sup>2</sup>. Plant to plant and row to row distances were kept as 10 cm and 100cm, respectively. The data on different traits was recorded and is presented in Table.

**Table-30 Performance of Pea Strains/Varieties in Normal Planting at Vegetable Research Institute, Faisalabad during 2015-16**

S. No.	Variety	Days to 50 % flower	No. of pods/plant	Seeds/pod	100-Seed Weight (g) Fresh	Green Pod Yield (T/ha)
1	Pea-09 (C)	52.00	11.2	5.8	64.09	9.07
2	Lina pak	43.00	10.4	7.4	45.67	8.43
3	9800-10	50.00	11.4	7.3	56.94	8.18
4	1300-8	51.67	11.7	6.6	47.19	7.73
5	2001-40	55.33	15.2	5.8	33.43	7.13
6	P-1500-1	61.00	10.6	5.8	27.00	6.15
7	PTL-3	86.00	15.8	6.4	25.85	6.13
8	PTL-7	85.32	12.6	7.2	25.47	6.05
9	PTL-1	59.33	13.0	7.4	27.04	5.35
10	Climax (C)	85.33	13.6	5.6	25.45	5.00
11	PTL-6	85.00	13.6	6.8	24.89	4.02
12	FS-2187	79.00	15.8	6.2	24.87	3.99
	<b>LSD (0.05)</b>	<b>0.77</b>	<b>4.19</b>	<b>1.32</b>	<b>4.31</b>	<b>1.12</b>

Differences of means due to genotypes were significant for all traits. Maximum green pod yield (9.07 t/ha) was produced by the check variety Pea-2009 followed by line Lina Pak (8.43 t/ha) which are statistically at par with the advance line 9800-10. Maximum seeds per pod were found in the lines Lina Pak and PTL-1 (7.4) followed by the line 9800-10 (7.3) which are statistically at par with each other. Maximum 100 seed weight of (64.09 g) was recorded for the check variety Pea-2009 followed by advance line 9800-10 (59.94 g) which are significantly higher from all other genotypes. The line Lina pak was earliest in producing 50% flowering in (43.00 days) while maximum days to 50% flowering were taken by variety Climax (85.33 days).

## **2.5 EVALUATION OF PEA VARIETIES/ADVANCE LINES FOR PRELIMINARY YIELD TRIAL FOR NORMAL PLANTING**

Twenty nine lines of peas were planted on 17-11-15 along with two check varieties at Faisalabad to study the performance of new lines in preliminary yield trial for normal planting time. The layout was conducted according to Randomized Complete Block Design with three replications in a plot size of  $3 \times 1 \text{ m}^2$ . Plant to plant and row to row distances were kept as 10 cm and 100cm, respectively. The data on different traits were recorded and is presented in the Table.

**Table-31 Performance of Pea Strains/Varieties in Preliminary Yield Trial at Vegetable Research Institute, Faisalabad during 2015-16**



S. No.	Variety/ Line	100-Seed Weight (g) Fresh	Green Pod Yield (t/ha)
1	<b>Climax (C)</b>	48.20	9.00
2	<b>Pea-2009 (C)</b>	56.67	7.31
3	1500-8	31.17	5.76
4	1500-13	26.07	5.48
5	1500-6	33.17	5.31
6	1500-5	34.23	5.21
7	1500-9	32.93	5.21
8	1500-3	28.80	5.17
9	1400-30	25.93	5.09
10	1500-15	30.34	5.00
11	1500-1	33.70	4.89
12	1500-19	25.47	4.85
13	1500-7	29.40	4.70
14	1500-20	25.90	4.67
15	1500-24	26.70	4.47
16	1500-21	26.63	4.44
17	1500-23	32.10	4.27
18	1500-11	30.90	4.18
19	1400-28	25.07	4.11
20	1500-22	26.53	3.88
21	1500-12	28.17	3.82
22	1500-14	28.53	3.75
23	1500-16	32.10	3.70
24	1500-25	28.97	3.58
25	1500-17	28.30	3.34
26	1400-1	25.83	3.33
27	1400-4	26.93	3.14
28	1500-2	32.27	3.12
29	1500-4	30.13	2.76
30	1500-18	29.30	2.66
31	1500-10	28.57	2.07
<b>LSD (0.05)</b>		<b>3.38</b>	<b>0.33</b>

Differences of means due to genotypes were significant for all studied traits. Maximum green pod yield of (9.00 t/ha) was recorded for the check variety Climax followed by check variety Pea-2009 (7.31 t/ha). None of the lines tested in preliminary yield trial gave yield at par with check varieties. Lowest yield (2.07 t/ha) was recorded for the line 1500-10. Highest fresh 100-seed weight of 56.67 was recorded for approved variety Pea-2009 while minimum 100 seed weight (25.07) was recorded for line 1500-28.

**2.6. ADAPTABILITY TRIAL OF EXOTIC PEA VARIETIES CONDUCTED AT VEGETABLE RESEARCH INSTITUTE, FAISALABAD DURING RABI 2015-16**

**Set-1**

Six pea varieties received from different seed companies were tested along with two locally cultivated check varieties at Vegetable Research Institute, Faisalabad. The trial was laid out according to RCB design with three replications on 13-10-2015. The planting geometry of the trial is as under:

Method of Sowing	Dibble sowing on both sides of the beds
Plot Size	4 × 0.80 m
Plant to plant spacing	5 cm
Bed width	80 cm

Standard cultural practices and plant protection measures were adopted. Data regarding days to 50% flowering, 100 seed weight (Fresh) and green pod yield were recorded and results are presented in the following table.

**Table-32 Performance of Exotic Pea Varieties at Vegetable Research Institute, Faisalabad during 2015-16**

Rank	Varieties/ Line	Days to 50% flowering	100 seed weight Fresh (g)	Green pod yield (t/ha)
<b>1</b>	<b>Pea-2009 (Check)</b>	<b>29.33</b>	<b>57.40</b>	<b>9.86</b>
2	Safeer	33.00	52.17	9.75
3	Asian chief	51.00	46.00	7.92
<b>4</b>	<b>Meteor (Check)</b>	<b>30.33</b>	<b>49.67</b>	<b>7.91</b>
5	Capital	31.00	45.67	7.11
6	Lina pak	30.67	49.73	6.63
7	Champion	33.67	46.33	5.48
8	Classic	49.00	47.10	5.24
	<b>LSD (0.05)</b>	<b>0.98</b>	<b>3.63</b>	<b>1.00</b>

The data presented in the above table reveals that none of the exotic variety / line surpassed the check variety Pea-2009 (9.86 t/ha). Imported variety Safeer produces yield (9.75 t/ha) which is at par with the check variety Pea-2009. Variety Classic produced the

lowest yield (5.24 t/ha). Data depicted that varieties Asian chief and Classic were found comparatively late as compared to check varieties.

### Set-2

Four pea varieties received from a seed company were tested along with two locally cultivated check varieties at Vegetable Research Institute, Faisalabad. The trial was laid out according to RCB design with three replications on 11-11-2015. The planting geometry of the trial is as under:

Method of Sowing	Dibble sowing on both sides of the beds
Plot Size	5× 1.60 m
Plant to plant spacing	5 cm
Bed width	80 cm

Standard cultural practices and plant protection measures were adopted. Data regarding days to 50% flowering, 100 seed weight (Fresh) and green pod yield were recorded and results are presented in the following table.

**Table-33 Performance of Exotic Pea Varieties at Vegetable Research Institute, Faisalabad during 2015-16**

Rank	Varieties/ Line	Days to 50% flowering	100 seed weight Fresh (g)	Green pod yield (t/ha)
<b>1</b>	<b>Pea-2009 (Check)</b>	<b>47.33</b>	<b>57.33</b>	<b>8.62</b>
2	Premium	38.00	43.43	8.47
<b>3</b>	<b>Meteor (Check)</b>	<b>46.33</b>	<b>39.60</b>	<b>8.00</b>
4	Super polo	37.67	37.83	7.92
5	Summer plus	64.00	26.13	7.89
6	Polo pak	48.00	34.83	6.97
<b>LSD (0.05)</b>		<b>0.35</b>	<b>2.2</b>	<b>0.57</b>

The data presented in the above table reveals that none of the exotic variety / line surpassed the check variety Pea-2009 (8.62 t/ha). Imported variety Premium produces yield (8.47 t/ha) which is at par with the check variety Pea-2009. Variety Polo Pak produced the lowest yield (6.97 t/ha). The data depicted that the exotic variety Summer plus is very late variety and got maximum days (64 days) to 50% flowering as compared with all other varieties.

### 3. BITTER GOURD (*Momordica charantia*)

#### 3.1 GERMPLASM COLLECTION and MAINTENANCE

To maintain the germplasm, a total of thirteen varieties/collections were sown on 2-03-16 in the observational plots with plot size measuring  $6.0 \times 2.5 \text{ m}^2$  by keeping the plant to plant distance of 45 cm. All standard agronomic practices were adapted. The germplasm was maintained through sib-mating.

#### 3.2 DEVELOPMENT OF INBRED LINES

The breeding material comprising of three  $S_0$ , three  $S_1$ , two  $S_2$ , seven  $S_3$ , five in  $S_5$ , twenty five from  $S_6$ , eleven in  $S_7$  and twelve in  $S_8$  progenies were planted in varying plot sizes on 02-03-16 according to the availability of seeds for inbred line development program. At flowering, germinated progenies were advanced through selfing. The detail of the successful selfed fruits obtained from the germinated lines is given in the table below.

**Table-34 Number of Successful Selfed Fruits obtained from Different Inbred lines**

Generations	No. of fruits
<b>S<sub>0</sub></b>	
Black king×888	1
HBG-37	2
<b>S<sub>1</sub></b>	
888 × Black king	2
1324 × Black king	1
<b>S<sub>2</sub></b>	
No.786	2
<b>S<sub>3</sub></b>	
HBG-34	2
<b>S<sub>4</sub></b>	
Raja	4
KHBG-37	4
<b>S<sub>6</sub></b>	
Fsd long	4
<b>S<sub>7</sub></b>	
Chaman	10
Collection-III	3

Collection-I	7
<b>S<sub>8</sub></b>	
Collection-II × Fsd. Long	2
Janpuri	10
Collection-II	2
<b>S<sub>9</sub></b>	
Collection-I × Fsd. Long	1
Nasarpuri × Fsd. Long	6

### 3.3 DEVELOPMENT OF BITTER GOURD OFF SEASON CULTIVARS

The development of cultivars in kareli through recurrent selection method is under way to cover the scarcity period from August to December. The crop was sown on 20-07-2016 for seed multiplication of developed bitter gourd line at Vegetables Research Institute, Faisalabad for further studies and distribution to farmers. The developed bitter gourd line “Safeena” was approved by Punjab seed council in its 47 meeting held on 15-07-2016 at Agriculture House Lahore, for general cultivation in Punjab.

### 3.4 EVALUATION OF BITTERGOURD VARIETIES/HYBRIDS IN ADAPTABILITY TRIAL FOR FEB-MARCH SOWING SEASON (Set-1)

An adaptability trial comprising of twelve genotypes, ten exotic received from different seed companies and two local checks (Faisalabad Long and Black King) was conducted on 2-03-16 in three replications at the experimental area of Vegetable Research Institute, Faisalabad in Randomized Complete Block Design. The plot size of the trial was kept as 3.0 × 2.5 m and plant to plant distance was maintained at 45 cm. The data recorded for fruit yield is presented in the table below.

**Table-32 Performance of different Bitter Gourd Varieties/Hybrids in Adaptability Trial at Vegetable Research Institute, Faisalabad during Kharif, 2016**

S. No.	Variety/Hybrid	Fruit Yield (t/ha)
1	<b>Black King ( Check)</b>	<b>14.35</b>
2	Prime F <sub>1</sub>	14.14
3	<b>Faisalabad long ( Check)</b>	<b>13.42</b>
4	HBG-153B	12.04

5	Bali F <sub>1</sub>	10.73
6	Sakuna 208 F <sub>1</sub>	10.02
7	BG-30	9.53
8	Victory F <sub>1</sub>	9.22
9	Crescent –one	8.18
10	Cross-888	7.55
11	HBG-154c	6.50
12	Advanta F <sub>1</sub> 103	5.65
<b>LSD (0.05)</b>		<b>3.13</b>

The data depicted that none of the exotic variety surpassed the check variety Black king, however the exotic varieties Prime and HBG-153B produced yield with values (14.14 t/ha) and (12.04 t/ha) which are statistically at par with the better check variety Black King with yield value (14.35 t/ha). So these lines could be tested for next year to confirm their adaptability. Lowest yield 5.65 t/ha was recorded from line Advanta F<sub>1</sub>103.

### Set-2

An adaptability trial comprising of twelve genotypes, ten exotic received from different seed companies and two local checks (Faisalabad Long and Black King) was conducted on 02-03-2016 in three replications at the experimental area of Vegetable Research Institute, Faisalabad in Randomized Complete Block Design. The plot size of the trial was kept as 3.0 × 2.5 m and plant to plant distance was maintained at 45 cm. The data recorded for fruit yield (t/ha) is presented in the table below.

**Table-33 Performance of different Bitter Gourd Varieties/Hybrids in Adaptability Trial at Vegetable Research Institute, Faisalabad during Kharif, 2016**

S. No.	Variety/Hybrid	Fruit Yield (t/ha)
<b>1</b>	<b>Black king (Check)</b>	<b>18.59</b>
2	Daisy F <sub>1</sub>	18.19
3	BG-402	17.10
4	Sonali	16.36
<b>5</b>	<b>Faisalabad long (Check)</b>	<b>16.04</b>

6	Sapna F <sub>1</sub>	15.27
7	BG-4719	12.86
8	Black F <sub>1</sub>	12.77
9	Ryan F <sub>1</sub>	11.44
10	Kundan F <sub>1</sub>	11.16
11	Advanta F <sub>1</sub> 110	10.72
12	BG-741	9.36
<b>LSD (0.05)</b>		<b>3.51</b>

The data depicted that check variety Black king (18.59 t/ha) performed better among all exotic varieties. However the exotic lines Daisy F<sub>1</sub> (18.19 t/ha), BG-402 (17.10 t/ha), Sonali (16.36 t/ha) and Sapna F<sub>1</sub> (15.27 t/ha) produced yields at par with the check varieties. So these lines could be tested in next year to confirm their adaptability.

### Set-3

An adaptability trial comprising of eight genotypes, six exotic received from different seed companies and two local checks (Faisalabad Long and Black King) was conducted on 02-03-2016 in three replications at the experimental area of Vegetable Research Institute, Faisalabad in Randomized Complete Block Design. The plot size of the trial was kept as 4.0 × 2.5 m and plant to plant distance was maintained at 45 cm. The data recorded for fruit yield (t/ha) is presented in the table below.

**Table-34 Performance of different Bitter Gourd Varieties/Hybrids in Adaptability Trial at Vegetable Research Institute, Faisalabad during Kharif, 2016**

S. No.	Variety/Hybrid	Fruit Yield (t/ha)
<b>1</b>	<b>Black king (Check)</b>	<b>17.37</b>
2	GHBG-1	17.04
3	Zarar	16.74
4	KHBG-1	16.71
5	NA-241	14.76
<b>6</b>	<b>Faisalabad long (Check)</b>	<b>13.19</b>
7	Sultan	12.83
8	Safa	10.40

<b>LSD (0.05)</b>	<b>4.8</b>
-------------------	------------

The data depicted that check variety Black king (17.37 t/ha) performed better among all exotic varieties. However the exotic lines GHBG-1 (17.04 t/ha), Zara (16.74 t/ha), KHBG-1 (16.71 t/ha) and NA-241 (14.76 t/ha) produced yields at par with the better check variety Black king. So these lines could be tested in next year to confirm their adaptability.

#### **4. CHILLIES (*Capsicum annuum*)**

##### **4.1 COLLECTION AND MAINTENANCE OF GERMPLASM**

For maintenance of germplasm, 163 genotypes were sown on 20.10.2015. Transplanting was carried out on 18.12.2015 under tunnel by keeping plant to plant distance of 45 cm in observational rows of 7.0 m long. At onset of flowering, tunnels were covered with net cloth to prevent cross pollination through insects. Selfed fruits (true to type) were harvested separately for further use in breeding program. Range of various traits in available germplasm is as under.

**Table-35 Range of Chillies Germplasm**

S. No.	Character	Range	
		Minimum	Maximum
1	Plant Height	20	120
2	Fruit Length	2	15
3	Fruit Diameter	0.5	3.0
4	Growth habit	Dwarf to tall	
5	Fruit position	Upward to downward	
6	Fruit color	Light green to dark purple	
7	Fruit bitterness	Less bitter to bitter	
8	Fruit behavior	Solitary to bunch	

##### **4.2 STUDY OF FILIAL GENERATIONS**

Objective of this trial is to evolve open pollinated varieties. During 2016, nursery of filial generations was sown on 29.10.2015 which includes 25 F<sub>1</sub> crosses, 16 F<sub>2</sub> populations, 28 F<sub>3</sub> populations, 37 F<sub>4</sub> populations, 18 F<sub>5</sub> populations and 13 F<sub>6</sub> populations. The transplanting was carried out on 09.02.2016 in open field. Single plant selections were made on the basis of plant structures, fruit shape and fruit size. Closed



flower buds of selected plants were covered with net cloth bags to ensure self pollination and to advance the generations for further studies to develop open pollinated varieties.

#### **4.3 PRELIMINARY EVALUATION OF PURE LINES OF CHILIES UNDER TUNNEL**

Twelve advanced lines along with one standard P-6 were sown in the nursery beds on 20.10.2015. Seedlings were transplanted on 18-12-2015 under tunnel in duplicated randomized complete plot design. Data was recorded for fresh green fruit yield and uniformity. All the genotypes exhibited varying degree of uniformity ranging from 20% to 30%. It is concluded that these lines need 2-3 more cycles of self pollination to attain acceptable level of purity. Moreover all the genotypes failed to give yield higher than standard.

**Table-36 Performance of Chillies Pure Lines under Tunnel in Preliminary Yield Trial at VRI, Faisalabad during 2015-16**

<b>S. No.</b>	<b>Genotype</b>	<b>Yield (t/ha)</b>
<b>1</b>	<b>P-6 (Check)</b>	<b>24.17</b>
2	VRICH 56	12.89
3	VRICH 2	10.84
4	VRICH 53	8.00
5	VRICH 68	7.39
6	VRICH 3	7.28
7	VRICH 19	7.12
8	VRICH 24	6.92
9	VRICH 41	5.46
10	VRICH 133	4.66
11	VRICH 90	4.57
12	VRICH 155	4.24
13	VRICH 38	2.09
<b>LSD (0.05%)</b>		<b>4.19</b>

#### **4.4 NATIONAL UNIFORM YIELD TRIAL FOR HOT PEPPER**

Ten varieties/ hybrids along with one standard received for NYUT were tested for their performance at Vegetable Research Institute, Faisalabad during Kharif 2015-16. Trial was conducted in randomized complete block design with two replications in open field. Nursery was sown on 04.11.2015 and transplanted on 09.02.2016. Plot size was kept as 6 × 0.75 m. The recommended agronomic and plant protection measures were adopted to maintain the crop. The data recorded for various traits and fresh green fruit yield is presented below.



**Table-37 Mean Performance of varieties/Hybrids in NYUT trial on Chillies 2015-16**

<b>Sr. #</b>	<b>Genotype</b>	<b>Yield (T/ha)</b>	<b>Yield/Plot (Kg)</b>	<b>Fruit Weight (gm)</b>	<b>Fruit Length (cm)</b>	<b>No. of Fruit / Plot</b>	<b>Fruit Shape</b>	<b>Fruit Color</b>
<b>1</b>	<b>CH15103</b>	6.81 <sup>D</sup>	3.07	2.40	6.05	1278	Narrow Triangular	Green
<b>2</b>	<b>CH15111</b>	6.80 <sup>D</sup>	3.06	2.48	7.80	1220	-do-	-do-
<b>3</b>	<b>CH15116</b>	15.42 <sup>A</sup>	6.94	3.78	8.10	1805	-do-	-do-
<b>4</b>	<b>CH15123</b>	12.30 <sup>B</sup>	5.53	3.02	6.65	1763	-do-	-do-
<b>5</b>	<b>CH15130</b>	16.05 <sup>A</sup>	7.23	4.39	7.85	1623	Horse shaped	-do-
<b>6</b>	<b>CH15133</b>	8.28 <sup>D</sup>	3.72	2.05	7.60	1790	Narrow Triangular	-do-
<b>7</b>	<b>CH15138</b>	7.52 <sup>D</sup>	3.38	2.35	5.90	1443	-do-	-do-
<b>8</b>	<b>CH15140</b>	16.80 <sup>A</sup>	7.58	4.35	8.15	1720	-do-	-do-
<b>9</b>	<b>CH15144</b>	3.27 <sup>E</sup>	1.47	3.34	7.90	520	Triangular	-do-
<b>10</b>	<b>CH15148</b>	10.09 <sup>C</sup>	4.54	3.29	8.00	1396	Narrow Triangular	-do-
<b>11</b>	<b>P-6 (Standard)</b>	11.53 <sup>B<sup>C</sup></sup>	5.19	4.19	8.10	1260	Horse shaped	-do-
	<b>LSD (5%)</b>	<b>1.7</b>						

#### 4.5 ADAPTABILITY REPORT OF HOT PEPPER VARIETIES/HYBRIDS AT VEGETABLE RESEARCH INSTITUTE FAISALABAD DURING 2015-2016

Sixty seven varieties/hybrids received from different seed companies were tested for their performance in adaptability trial at Vegetable Research Institute, Faisalabad during 2015-16. The crop was sown in three sets, one under tunnel and two in open field depending upon the provision of seed samples by different seed companies. The trials were laid out in randomized complete block design with three replications. The recommended agronomic and plant protection measures were adopted to maintain the crop. The data recorded for fresh green fruit yield is presented below. During the months of April to June, high temperature reduced the fruit setting and ultimately resulted in low yield.

##### Adaptability trial under tunnel (Set-I)

No. of varieties/Hybrids: 25 + 1 (Check)  
 Date of nursery sowing: 20.10.2015  
 Date of transplanting: 10.12.2015  
 Plot size: 4 × 0.75 m  
 Plant to plant distance: 0.45 cm

**Table-38 Performance of Hot Pepper Under Tunnel (Set-1)**

Rank	Entry	Yield (t/ha)
1	Fengaio No. 02	34.80
2	Super Hot F <sub>1</sub>	33.86
3	BSS-410	30.30
4	SV7864HM	30.06
5	P-6 (Check)	27.33
6	Green King	27.31
7	Big Daddy	27.13
8	Big Red AB	27.00
9	Glory F <sub>1</sub>	26.95
10	Patyala F <sub>1</sub>	26.92
11	Super Sky AB	26.87
12	Uttal	26.74
13	Omega	24.73
14	Hot Shot F <sub>1</sub>	23.10
15	Super King F <sub>1</sub>	23.07
16	Galaxy 2 F <sub>1</sub>	22.80
17	Hot-708	22.77
18	Revival	21.83

19	BPVCL 14-1	20.99
20	Silky Red F <sub>1</sub>	20.95
21	Tejal	20.39
22	Amber F <sub>1</sub>	18.48
23	HP-033	17.12
24	Angel F <sub>1</sub>	16.27
25	PH-275	14.88
26	G-HHP-01	14.38
<b>LSD (0.05)</b>		<b>1.79</b>

It is evident from above table that hybrid “Fengiao No. 02” ranked 1<sup>st</sup> with yield value of 34.80 t/ha. It has downward fruiting habit. It exhibited good fruit setting during months of April to June, but showed high susceptibility to viruses during month of July. “Super Hot F<sub>1</sub>” ranked 2<sup>nd</sup> (33.86 t/ha) and also has same fruiting habit. It is early yielder as well as exhibit good fruiting at high temperature. “BSS-410” ranked 3<sup>rd</sup> (30.30 t/ha). It is also early yielder and seems to be virus tolerant. “SV7864HM” was only variety/hybrid with upward fruiting habit to show significantly higher yield than standard “P-6”. SV7864HM seems to have long fruiting period and exhibited very good fruit setting at low as well as high temperature with moderate virus tolerance.

Moreover, varieties/hybrids from rank # 6-12 are statistically at par in comparison with check “P-6”.

#### Note

A variety / Hybrid “Chilli 555 F<sub>1</sub>” submitted by “Naveel Seed Corporation” did not germinate despite of two times sowing. So not included in results.

#### Adaptability trial in open field (Set-II)

No. of varieties/Hybrids: 28 + 1 (Check)

Date of nursery sowing: 03.11.2015

Date of transplanting: 09.02.2016

Plot size: 7 × 0.75 m

Plant to plant distance: 0.45 m

**Table-39 Performance of Hot Pepper in Open Field (Set-II)**

Rank	Entry	Yield (t/ha)
1	Quick Mirch	22.65
2	Star Mirch	19.76
3	Laal Mirch	19.22
4	GSL 119	19.02
5	KHHP-081A	18.94
6	1130 F <sub>1</sub>	18.23

7	Skyway	17.25
8	Asian Hot F <sub>1</sub>	17.02
9	Tez Mirch	16.10
10	GSL 111	14.77
11	P-6 (Check)	14.58
12	Advanta 5017 F <sub>1</sub>	14.38
13	Advanta 512 F <sub>1</sub>	13.98
14	Chief Mirch	13.95
15	EW 1208 F <sub>1</sub>	13.77
16	Sky Red	13.77
17	Skyline 2	13.62
18	German	13.53
19	CBS 1292	13.50
20	THP-033	13.15
21	Nun 2074 F <sub>1</sub>	12.31
22	KP 1305 F <sub>1</sub>	12.09
23	KHHP-083 C	11.94
24	Rainbow	11.07
25	CBS 129	10.81
26	KHHP-082 B	8.65
27	Green Fire	8.33
28	7-AP	8.32
29	Thong Khao 20	7.19
<b>LSD (0.05)</b>		<b>1.1</b>

In Set II, “Quick Mirch” ranked 1st with 22.65 t/ha fresh green fruit yield. Quick Mirch seems to be early yielder with very long fruit and high fruit weight. The lowest yield (7.19 t/ha) was recorded in Thong Khao 20. Moreover, varieties/hybrids from rank # 1-9 showed significantly higher yield than check “P-6”.

#### **Note**

A variety/Hybrid “KHHP-084 D” was submitted by “Kanzo Quality Seeds” as hot pepper. But after fruiting, it proved to be bell pepper and was also asked to the concerned company. So not included in results.

#### **Adaptability trial in open field (Set-III)**

No. of varieties/Hybrids: 12 + 1 (Check)  
Date of nursery sowing: 23.12.2015  
Date of transplanting: 10.03.2016  
Plot size: 6 × 0.75 m  
Plant to plant distance: 0.45 m

**Table-40 Performance of Hot Pepper in Open Field (Set-III)**

Rank	Entry	Yield (t/ha)
1	PE-101 F <sub>1</sub>	6.26
2	P-6 (Check)	6.21
3	007 F <sub>1</sub>	5.95
4	PE-404 F <sub>1</sub>	5.69
5	PE-102 F <sub>1</sub>	5.55
6	Sky Cross F <sub>1</sub>	5.51
7	Sky Shot F <sub>1</sub>	5.42
8	KHHP-085 E	4.89
9	Red Gold	4.82
10	Sundari F <sub>1</sub>	4.78
11	Xiangla-712	3.78
12	Rexy F <sub>1</sub>	3.40
13	N-Xiangla-2	3.17
<b>LSD (0.05)</b>		<b>0.72</b>

In Set-III, “PE-101 F<sub>1</sub>” gave the highest yield (6.26 t/ha) followed by “P-6” with yield value of 6.21 t/ha. Yield of hybrids/varieties from rank # 3-6 are also at par in comparison with check “P-6”.

**Note**

Varieties/Hybrids in Set-III were received very late. Due to this reason, these varieties gave very low yield as compared to earlier sets.

**5. SWEET PEPPER (*Capsicum annum*)****5.1 ADAPTABILITY REPORT OF SWEET PEPPER VARIETIES/HYBRIDS SOWN AT VEGETABLE RESEARCH INSTITUTE FAISALABAD DURING 2015-16**

Fifteen varieties/hybrids received from different seed companies were tested for their performance in adaptability trial in three sets, two under tunnel and one in open field at Vegetable Research Institute, Faisalabad during 2015-16. The trials were laid out in randomized complete block design with three replications. The recommended agronomic and plant protection measures were adopted to maintain the crop. The data recorded for fresh green fruit yield is presented below.

**Set-I**

No. of varieties/Hybrids: 8  
Date of nursery sowing: 20.10.2015

Date of transplanting: 10.12.2015  
 Plot size: 3 × 0.75 m  
 Plant to plant distance: 0.45 cm

**Table-41 Performance of Sweet Pepper under Tunnel (SET-I)**

Rank	Entry	Yield (t/ha)
1	Asha F <sub>1</sub>	33.26
2	Kanzo Commander Shimla	29.79
3	SP-41	29.67
4	SP-42	27.75
5	Kanzo Jumbo Shimla	27.54
6	Freedom F <sub>1</sub>	26.28
7	Capino F <sub>1</sub>	23.60
8	Super Globe	22.05
<b>LSD (0.05)</b>		<b>2.06</b>

The above table shows that the variety/hybrid Asha F<sub>1</sub> exhibited the highest fresh green fruit yield (33.26 t/ha) followed by “Kanzo Commander Shimla” and “SP-041” with yield values of 29.79 t/ha and 29.67 t/ha, respectively. Super Globe showed susceptibility to root rot.

#### **Set-II**

No. of varieties/Hybrids: 5  
 Date of nursery sowing: 03.11.2015  
 Date of transplanting: 14.01.2016  
 Plot size: 3 × 0.75 m  
 Plant to plant distance: 0.45 cm

**Table-42 Performance of Sweet Pepper under Tunnel (SET-II)**

Rank	Entry	Yield (t/ha)
1	Savio	27.89
2	Coral F <sub>1</sub>	27.75
3	TSP 041	26.66
4	Astra-2	25.36
5	Alina F <sub>1</sub>	12.88
<b>LSD (0.05)</b>		<b>2.8</b>

Overall yield of varieties/hybrids tested in set II was low due to late sowing and transplanting. The above table shows that the variety/hybrid Savio F<sub>1</sub> exhibited the highest fresh green fruit yield (27.89 t/ha) followed by “Coral F<sub>1</sub>” and “TSP-041” with yield values of 27.75 t/ha and 26.66 t/ha, respectively.



**Adaptability trial in Open Field (Set-III)**

No. of varieties/Hybrids:	2
Date of nursery sowing:	23.12.2015
Date of transplanting:	10.03.2016
Plot size:	6 × 0.75 m
Plant to plant distance:	0.45 m

**Table-43 Performance of Sweet Pepper in Open Field (SET-III)**

Rank	Entry	Yield (t/ha)
1	Capisto F <sub>1</sub>	7.24
2	Orbit F <sub>1</sub>	5.32

These two hybrid/samples were received very late, and tested under open field. At the time of sowing temperature was very low and the germination of the entries was very late. Due to this reason, both entries yielded very low. The above table shows that the variety “Capisto” exhibited higher fresh green fruit yield (7.24 t/ha).

**6. CARROT (*Daucus carota*)****6.1 COLLECTION AND MAINTENANCE OF GERMPLASM IN CARROT**

10 genotypes viz; 5 Red Genotypes (DC-3, DC-4, DC-90, DC-W and T-29), Purple genotypes (DC-B), Yellow genotype (1) and Orange genotype (1) were sown on 17-09-2015 for their maintenance. All the recommended agronomic and plant protection measures were adapted. All the genotypes were selected and sibbed in isolation chamber. The genotype DC-4 remained in field till the end of March and frost tolerant non bolters were selected to develop market acceptability for late season.

The “Black Carrot” (DC-B) was selected for purity and uniformity of purple pigments throughout xylem and phloem. Small quantity of seed of the genotype is available for future manipulation.

**6.2 DEVELOPMENT OF CARROT VARIETIES FOR EARLY SOWING**

Three Populations viz; DC-3, DC-90, and DC-W were sown on 28-08-2015. The sowing was done on both sides of 75 cm wide ridges. Selection was done on the basis of marketable roots and transplanting of selected roots was done after 90 days for DC-90 and more than 100 days after sowing date for remaining genotypes to develop the lines for short and normal span of the crop. The line DC-90 is early bulking with variable root and core color. DC-3(red core) and DC-W (white core) are slightly early genotypes. All three lines are slightly light in skin color as compared to Indian lines in the market. To

improve the population for bright outer skin color, lines were crossed with purple line to develop populations with darker skin color to compete Indian varieties for skin color of the roots which will be further improved by mass selection of the population.

### **6.3 DEVELOPMENT OF CARROT VARIETY SUITABLE FOR LATE PLANTING**

Two Populations viz; DC-4(Red) and Orange-2007 are being developed for late planting and late bulking. The sowing was done on both sides of 75 cm wide ridges on 26.10.2015. Plant to plant distance was kept as 3 cm by thinning after three weeks of germination. Selection was based on resistance to frost, marketable root development and non-bolting behavior till the end of March. To develop a frost tolerant and late bolting variety for longer supply, severe selection against bolting and susceptibility to frost remained in progress till March. Moreover plants resistant to frost with marketable roots were harvested which produce small amount of seed for further use in future. Orange 2007 is the only single variety locally developed having orange flesh, frost tolerance and late bolter. It requires further population improvement.

Marketability of DC-W as compared to other all varieties was very low. Bolting behavior shows that variety can easily be prone to low bolting and high marketability for late sowing through vigorous marketable root selection. All varieties were susceptible to frost except Orange-07. Orange-07 is only single locally developed orange variety for late sowing. Moreover DC-4 (developed for late season) showed very good promises for frost tolerance along with high marketability and low bolting behavior which give it an advantage over T-29 for late sowing. Furthermore in order to enhance frost tolerance, root marketability and yield, severe selection was done and roots were transplanted in isolation.

### **6.4 DEVELOPMENT OF CMS LINES**

Forty five crosses between BC-2 and F<sub>3</sub> were sown on 05-09-2015 and transplanted under isolation cages to take BC-3 and F<sub>4</sub>. Moreover 9 Genotypes during previous year showed complete restoration of fertility level. All the material including Back Crosses, F<sub>4</sub> generations and fertile male single plants will be used for further back crosses and selfing to develop three line breeding systems for hybrid development.

## 6.5 ADAPTABILITY / VARIETAL TRIAL OF CARROT AT VEGETABLE RESEARCH INSTITUTE FAISALABAD

14 carrot varieties/hybrids received from different seed companies were tested for their performance at Vegetable Research Institute, Faisalabad during Rabi 2015-16. Trial was conducted in randomized complete block design with four replications. The plot size was kept as 8.0 m x 0.75 m. The recommended agronomic and plant protection measures were adopted to maintain the crop. The data recorded for root yield is presented below.

**Table-44 Performance of Carrot Varieties/Hybrids**

Date of Sowing : 11-09-2015		Date of harvesting: 22-01-2016
Rank	Variety / Hybrid	Yield (t/ha)
1	DC-90	82
2	KQS-KCR-1	78
3	Sun seed	73
4	T-29	72
5	DC-3	70
6	Long Red	69
7	DC-W	69
8	American Beauty	67
9	Nayab	65
10	Kirti Rose	55
11	Fire Wedge	52
12	P2	52
13	Doctor	39
14	Sigma	34
<b>LSD (0.05)</b>		<b>1.7</b>

Advanced line of Vegetable Research Institute “DC-90” ranked 1<sup>st</sup> with 82 t/ha root yield followed by KQS-KCR-1 and Sunseed. Sigma stood last with 34 T/Ha root yield.

## 7. RADISH (*Raphanus sativus*)

### 7.1 ADAPTABILITY TRIAL OF EXOTIC RADISH VARIETY

The trial consisting of eleven varieties was planned to evaluate the radish varieties for yield and yield components. The trial was sown on 1-10-015 in triplicate RCB design

keeping plot size of  $8.0 \times 0.75\text{m}$ . The sowing was done on both sides of ridges made 75 cm apart. Yield data collected is given in table.

**Table-45 Performance of Late Radish Varieties in Adaptability Trial at VRI, Faisalabad 2015-016**

S. No.	Variety	Root+Leave yield (t/ha)
1	Desi White	109.07
2	Mino Selection	102.4
3	YR White Spring	87.68
4	Green Bow	86.25
5	Advanta	84.44
6	Early White Long	82.61
7	Mino Local	76.62
8	Lal Pari	66.99
9	Gang Seong	56.42
10	Red Meat	55.97
11	Biz	0.00
<b>LSD (0.05)</b>		<b>12.33</b>

The table reveals that varieties were statically significant for yield. The maximum yield was given by Desi White (109.07 t/ha) followed by Mino Selection (102.4t/ha).

## 7.2 ADAPTABILITY TRAIL OF EXOTIC RADISH VARIETY (Late)

The trial consisting of five varieties was planted to evaluate the radish varieties for yield and yield components. The trial was shown on 30-12-2015 in triplicate RCB design keeping plot size of  $8.0 \times 0.75\text{m}$ . The sowing was done on both sides of ridges made 75 cm apart. Yield data collected is given in table.

**Table-46 Performance of Radish Varieties in Adaptability Trial at VRI, Faisalabad 2015-016**

S. No.	Variety	Root+Leave yield (t/ha)
1	Radish 025 F <sub>1</sub>	67.16
2	Gang Seong	65.59

3	Early long White	60.70
4	Mino Selection	41.97
5	Purple Neck	34.58
<b>LSD (0.05)</b>		<b>5.08</b>

The table reveals that varieties were statically significant for yield. The maximum yield was given by Radish 025 (67.16 t/ha) followed by Gang Seong (65.59 t/ha).

### 7.3 PRE-BASIC SEED PRODUCTION IN RADISH

To maintain the purity, seed of five radish varieties viz., Mino Local, 40 Days, Desi White, Mino selection and Lal Pari was sown during the month of September, 2015. The off-type plants keeping in view the leave and root characteristics (shape and root colour) from different varieties were removed. The true to type roots of specific variety were selected at harvest. Steckling of selected root were made and planted during the month of December, 2015 for the production of pre-basic seed in isolation (1000m). Early bolters and late bolters were rouged out from the seed production plots to maintain the variety. Detail of the seed produced is given in table below.

**Table-47 Pre-basic seed produced during 2015-16**

S. No.	Variety	Quantity (g)
1	40 Days	4000
2	Desi White	200
3	Lal Pari	400
4	Mino Selection	1000

## 8. TURNIP (*Brassica comprestis* var. *rapa*)

### 8.1 EVALUATION OF TURNIP VARIETIES FOR YIELD

The trial was conducted to evaluate the performance of eight varieties viz; Green top, purple top, White, Purple Golden, Purple Prince, Golden, Desi Red and Purple. The lay out was according to RCBD with three replications. The sowing of these varieties was done on 1-10-2015. The lay out was according to RCBD with three replications. The sowing was done on ridges made 75 cm apart in a plot size of 8 × 0.75. All agronomic

and plant protection measures were adopted to maintain the crop. The data recorded for root and leave yield is presented in the table below.

**Table-48 Performance of Turnip Variety in Adaptability Trial at VRI, Faisalabad 2015-16**

S. No.	Variety	Root + leave Yield (t/ha)
1	Desi Red	73.30
2	Green Top	69.94
3	White	65.81
4	Purple Top	64.29
5	Golden	56.70
6	Purple Golden	53.77
7	Purple	49.66
8	Purple Prince	43.83
<b>LSD (0.05)</b>		<b>8.74</b>

The maximum yield (73.30 t/ha) was produced by variety Desi Red, followed by Green Top with yield of 69.94 t/ha. Data was found significant statistically. All pair wise comparison was used to compare the yield.

## 8.2 EVALUATION OF TURNIP VARIETIES FOR YIELD (Late)

Five Turnip varieties Stylo F<sub>1</sub>, Kansas, Golden World, Golden and Purple Top were evaluated at Vegetable Research Institute, Faisalabad. The sowing of these varieties was done on 30-12-015. The lay out was according to RCBD with three replications. The sowing was done on ridges made 75 cm apart in a plot size of 8 × 0.75m. All agronomic and plant protection measures were adopted to maintain the crop. The data recorded for root and leave yield is presented in the table below.

**Table-49 Performance of Turnip Variety in Adaptability Trial at VRI, Faisalabad 2015-16**

S. No.	Variety	Root+leave yield (t/ha)
1	Stylo F <sub>1</sub>	32.96
2	Purple Top	28.11
3	Kansas	27.08

4	Golden World	22.86
5	Golden	22.63
<b>LSD (0.05)</b>		<b>3.24</b>

The maximum yield (32.96 t/ha) gave by variety Stylo F<sub>1</sub>, followed by Purple Top with yield of 28.11 t/ha. Data was found significant statistically. All pair wise comparison was used to compare the yield.

### **8.3 IMPROVEMENT OF TURNIP ADVANCE STRAINS**

The selfed seed of three advance strains *viz*; Purple, White and Green Top were sown on 1-10-015 maintaining row to row distance of 75 cm. At market maturity, the desirable root of White, Purple and Green Top were selected keeping in view the root color, shape, size and stacking were made. The stacking of all genotypes were planted on 7-12-2015 in isolation to maintain the purity of the genotypes. The early bolter and diseased plants were rouged out. At maturity harvesting was done and 150, 250 and 150 g seed of White, Purple and Green Top, respectively, was obtained.

### **8.4 DEVELOPMENT OF HEAT TOLERANT VARIETY**

Random mated population (3<sup>rd</sup> selection cycle) was sown on 12-8-2015 for selection of heat tolerance. Plants were selected on the basis of root shape and size. At maturity for marketable root, selected roots were planted on 22-10-2015 for seed production under random mating for 5<sup>th</sup> selection cycle. At maturity of seed crop 200 g of seed was collected.

### **8.5 PRE-BASIC SEED PRODUCTION IN TURNIP VARIETIES**

Single plant progenies of Purple Top Punjab and Golden varieties were sown on 1-10-2015 on both sides of ridges made 75 cm apart. Thinning was done at early stage to get vigorous roots of good shape. All off type plants from both varieties were rouged out to maintain the purity of the varieties. The stecklings of desirable and true to type roots in the varieties of Purple Top and Golden were planted on 6-12-2015, respectively, in isolation. Early bolters, late bolters and diseased plants were rouged out from the plots of both varieties. At crop maturity 100 single plants of Purple Top and 51 single plants of Golden Ball Faisalabad were harvested and seed was collected for the production of next

year pre-basic seed. Pre-basic seed of 350 g of variety Purple Top and 500 g seed of golden was produced.

## 9. MUSKMELON (*Cucumis melo*)

### 9.1 EVALUATION OF MUSKMELN VARIETIES IN FIELD CONDITION, 2016

Fourteen Muskmelon varieties/hybrids: Isabeel F<sub>1</sub>, Sweety, Rchana F<sub>1</sub>, Badsha F<sub>1</sub>, NSC-7 F<sub>1</sub>, NSC-1, HSM062Aa, HSM-051A, Honey-7 F<sub>1</sub>, Honey plus F<sub>1</sub>, Sweat 010, Ye-68-11, Honey -15-F<sub>1</sub>, Star-1-F<sub>1</sub> were tested in field at Vegetable Research Institute, Faisalabad along with Ravi and T-96 as a check. The sowing of these varieties was done on 25-2-2016 in field. The lay out was according to RCBD with three replications. The sowing was done on bed made 300 cm apart with plot size of 8 × 3m. All agronomic and plant protection measures were adopted to maintain the crop. The data recorded for fruit yield and TSS is presented in the table below.

**Table-50 Performance of muskmelon Varieties in Adaptability Trial at VRI, Faisalabad 2016**

S. No.	Varieties	Yield (t/ha)	TSS (%)
1	Isabeel F <sub>1</sub>	9.52	9
2	Badsha F <sub>1</sub>	9.34	7
3	<b>T-96</b>	9.22	14
4	NSC-7 F <sub>1</sub>	9.12	13
5	Sweety F <sub>1</sub>	8.61	9
6	Star-1-F <sub>1</sub>	8.31	7
7	Rchana,F <sub>1</sub>	7.74	12
8	HSM062A	7.73	9
9	Honey-7F <sub>1</sub>	5.57	10
10	Sweat 010	7.46	11
11	Honey -15-F <sub>1</sub>	7.32	6
12	HSM-051A	7.22	13
13	Honey plus F <sub>1</sub>	7.19	13
14	<b>VRIM-10</b>	5.64	13
15	NSC-1	5.54	9



16	Ye-68-11	3.40	10
<b>LSD (0.05)</b>		<b>5.40</b>	

The maximum fruit yield (9.52 t/ha) with TSS value of 9 % was given by variety Isabeel F<sub>1</sub> followed by Badsha F<sub>1</sub>, with fruit yield of 9.34 t/ha with TSS value of 7%. All varieties were found significant statistically regarding fruit yield.

## 9.2 EVALUATION OF MUSKMELN VARIETIES UNDER PLASTIC TUNNEL, 2016

Six Muskmelon varieties/hybrids G-HSM -1, K-HSM-1, HSM-053B, Golden Queen, Sweet Beauty and Snow White F<sub>1</sub> were tested under low tunnel at Vegetable Research Institute, Faisalabad along with VRIM-10 and T-96 as a check. The sowing of these varieties was done on 4-12-2015 under plastic tunnel. The lay out was according to RCBD with three replications. The sowing was done on bed made 300 cm apart with plot size of 8 x 3m. All agronomic and plant protection measures were adopted to maintain the crop. The data recorded for fruit yield and TSS is presented in the table below.

**Table-51 Performance of Muskmelon Varieties in Adaptability Trial at VRI, Faisalabad 2016**

S. No.	Varieties	Yield (t/ha)	TSS (%)
1	<b>T-96</b>	<b>10.36</b>	<b>13</b>
2	VRIM-10	7.80	12
3	KHSM-1	7.78	9
4	HSM0.53B	7.19	9
5	Golden Queen	6.15	10
6	G-HSM-1 F <sub>1</sub>	6.11	9
7	Sweet Beauty	5.09	11
8	Snow White F <sub>1</sub>	0	
<b>LSD (0.05)</b>		<b>3.00</b>	

The maximum fruit yield (10.36a t/ha) with TSS value of 13 % gave by variety T-96 followed by VRIM-10 (F<sub>1</sub>), with fruit yield of 7.80 t/ha with TSS value of 12%. All varieties were found significant statistically.

### 9.3 DEVELOPMENT OF HYBRIDS/INBREAD IN MUSKMELON

Selected inbred lines (VRIM-9 and VRIM-10) was sown during 2<sup>nd</sup> fortnight of December 2015, keeping plant to plant and row to row distance of 60 cm and 300 cm, respectively, under plastic tunnel to enhance temperature. During first week of March, 2016 the tunnel was covered with nylon net to make isolation chamber to avoid pollinators. Female flowers were selfed with respective male parent manually. Furthermore all genotypes were selfed / sibed to get at least one mature fruit in each genotype to maintain the inbred lines.

## 10. WATER MELON (*Cucumis melo*)

### 10.1 EVALUATION OF EXOTIC WATERMELON VARIETIES/HYBRIDS IN ADAPTABILITY TRIAL UNDER LOW PLASTIC TUNNEL

Five hybrids/varieties along with check hybrids/varieties Sugar baby and Black beauty were sown on 11-12-2015 to check their adaptability under low plastic tunnel. Sowing was done 45-50 cm apart in hills, according to Randomized Complete Block Design with three replications keeping plot size of 7.0 m × 3.0 m. Germination of all the hybrids/varieties was satisfactory. Agronomic practices and plant protection measures were adopted regularly. Data regarding fruit yield were recorded and presented in the following table.

**Table-53 Yield Performance of various Varieties/Hybrids of Watermelon during 2015-16**

S. No.	Variety / Hybrid	Yield (t/ha)
1	GSL-13	26.49
2	Orion-F <sub>1</sub>	24.98
3	CBS-11	24.49
4	Cheeta-F <sub>1</sub>	22.94
5	<b>Black Beauty (Check)</b>	<b>21.49</b>
6	<b>Sugar Baby (Check)</b>	<b>20.54</b>
7	Gorilla-F <sub>1</sub>	19.34
<b>LSD (0.05)</b>		<b>2.2</b>

It is evident from the above table that the hybrid GSL-13 exhibited the highest fruit yield of 26.49 t/ha followed by hybrid Orion-F<sub>1</sub> 24.98 t/ha whereas, the hybrid/variety Gorilla-F<sub>1</sub> showed the lowest fruit yield 19.34 t/ha.

## 10.2 EVALUATION OF EXOTIC WATERMELON VARIETIES/HYBRIDS IN ADAPTABILITY TRIAL

Sixteen entries in set-I and set-II, fifteen in set-III and seventeen in set-IV along with check variety Sugar baby were sown on 26-02-2016 to check their adaptability. Sowing was done 45-50 cm apart in hills, according to Randomized Complete Block Design with three replications keeping plot size of 7.0 x 3.0 m. Germination of all the hybrids/varieties was satisfactory. Severe hail storm at seedling stage (2<sup>nd</sup> leaf stage) damaged the crop stand and re-sowing of the damaged seedling was done. At fruit development stage heavy rainfall along with thunderstorm affected the crop that not only reduces the crop yield but also caused fruit rotting. Agronomic practices and plant protection measures were adopted regularly. Data regarding fruit yield were recorded and presented in the following tables.

**Table-54 Yield Performance of various Varieties/Hybrids of Watermelon during 2016 (Set-I)**

S. No.	Variety / Hybrid	Yield (t/ha)
1	Shoulder	23.83
2	1250-F <sub>1</sub>	21.72
3	Bpvw-14-1	20.99
4	Capsule-F <sub>1</sub>	20.95
5	WM-1648	20.75
6	My Honey	20.47
7	Ayesh	20.43
8	Noor-F <sub>1</sub>	20.16
9	Big Top ACS	19.76
10	<b>Sugar Baby (Check)</b>	<b>19.42</b>
11	Cobra	19.34
12	WM-483	18.87
13	Veer-F <sub>1</sub>	18.78
14	WM-482	18.54

15	Super Star ACS	18.23
16	Laal Badshah	17.74
<b>LSD (0.05)</b>		<b>2.4</b>

The data presented in table-54 reveals that all the hybrids/varieties showed highly significant differences for fruit yield. The hybrid/variety Shoulder exhibited the highest fruit yield of 23.83 t/ha followed by hybrid 1250-F<sub>1</sub> 21.72 t/ha whereas, the hybrid/variety Laal Badshah showed the lowest fruit yield 17.74 t/ha in set-I.

**Table-55 Yield performance of various Varieties/Hybrids of Watermelon during 2016 (Set-II)**

S. No.	Variety/Hybrid	Yield (t/ha)
1	Advanta-1401	27.06
2	Advanta- F1-1431	24.20
3	KHWM-063	23.90
4	Advanta- F1-1445	23.59
5	Aswm-72-55	23.24
6	G-HWM-1	22.24
7	Advanta- F1-1436	22.19
8	Black Happy- F <sub>1</sub>	21.71
9	552-F <sub>1</sub>	21.55
10	HWM-271 A	21.26
11	Rocket-F <sub>1</sub>	21.15
12	Turi-F <sub>1</sub>	20.54
13	Sweet King	19.68
14	HWM-251 A	19.63
15	<b>Sugar Baby (check)</b>	<b>19.23</b>
<b>LSD (0.05)</b>		<b>2.8</b>

The data presented in table-55 reveals that difference among means due to hybrids/varieties were significant at 5 % level of significance for fruit yield. The hybrid/variety Advanta-1401 gave the highest fruit yield of 27.06 t/ha followed by

hybrid/variety Advanta-F<sub>1</sub>-1431 (24.20 t/ha ) whereas, the variety Sugar Baby (check) showed the lowest fruit yield 19.23 t/ha in set-II.

**Table-56 Yield performance of various Varieties/Hybrids of Watermelon during 2016 (Set-III)**

S. No.	Variety / Hybrid	Yield (t/ha)
1	Red Star	25.71
2	Lusia	25.00
3	Nun-8674	24.44
4	Round-8	24.34
5	Black Tiger	24.05
6	Hitto-F <sub>1</sub>	23.33
7	Vezel-F <sub>1</sub>	22.86
8	Zinco-F <sub>1</sub>	22.62
9	Ayesha	21.95
10	Mego-10	21.93
11	Puma-F <sub>1</sub>	21.78
12	Carlos-F <sub>1</sub>	21.44
13	Charlos-F <sub>1</sub>	21.42
14	Jerry-F <sub>1</sub>	19.64
15	<b>Sugar Baby (check)</b>	18.57
<b>LSD (0.05)</b>		<b>2.5</b>

Data presented in the above table-56 reveals that hybrid/variety Red Star exhibited the highest fruit yield of 25.71 t/ha followed by hybrid/variety Lusia 25.00 t/ha whereas, the variety Sugar Baby (check) showed the lowest fruit yield 18.57 t/ha in set-III.

**Table-57 Yield Performance of various Varieties/Hybrids of Watermelon during 2016(Set-IV)**

S. No.	Variety / Hybrid	Yield (t/ha)
1	Vera-F <sub>1</sub>	26.18
2	Haider-F <sub>1</sub>	24.95

3	Red Tiger-59	24.44
4	Jamjuri-55	24.06
5	Doblin-F <sub>1</sub>	23.79
6	Dulice-F <sub>1</sub>	23.71
7	Capton	23.24
8	Star-434-F <sub>1</sub>	22.89
9	3550-F <sub>1</sub>	22.52
10	WT-1604	22.18
11	WT-4001	21.91
12	WT-1606	21.86
13	WT-4002	21.79
14	Don-F <sub>1</sub>	21.41
15	Doblin	21.23
16	<b>Sugar Baby (check)</b>	20.72
17	Black Star	17.16
<b>LSD (0.05)</b>		<b>4.7</b>

Data presented in the above table-57 reveals that hybrid/variety Vera-F<sub>1</sub> exhibited the highest fruit yield of 26.18 t/ha followed by hybrid/variety Haider-F<sub>1</sub> 24.95 t/ha whereas, the variety Black Star showed the lowest fruit yield 17.16 t/ha in set-IV.

### **10.3 DEVELOPMENT OF INBRED LINES IN WATER MELON**

The seed of 4 S<sub>5</sub> progenies/lines was sown in fruit to row fashion on 01-04-2015 on both sides of 3 meter wide beds keeping plant to plant distance of 60 cm. 2-3 flowers on 3-4 selected plants in each bed were selfed to get at least one mature fruit for generation advancement. At maturity selfed seed of 4 S<sub>5</sub> lines was collected.

### **10.4 DEVELOPMENT OF OPEN POLLINATED VARIETIES IN WATER MELON**

From broad based population, two types of fruits were selected (Green oblong and green round) and maintained by sowing in isolation. These were sown on 01-04-2015 in isolation on both sides of 3 meter wide beds, keeping plant to plant distance of 60 cm. Plants having desirable fruits on the basis of rind color, shape and TSS %age were selected.

## 11. CAULIFLOWER (*Brassica oleracea* Var. botrytis)

### 11.1 EVALUATION OF EXOTIC CAULIFLOWER VARIETIES/HYBRIDS SUITABLE FOR 2<sup>ND</sup> EARLY SEASON IN ADAPTABILITY TRIAL

Three F<sub>1</sub> hybrids viz; Advanta 403, C-002 and Tabinda-F<sub>1</sub> along with check variety (FD-II) were sown in nursery on 01.07.15 to check their adaptability. Germination of all the hybrids/varieties was satisfactory. The experiment was laid out according to Randomized Complete Block Design with three replications keeping plot size of 7.0m × 0.75m. The nursery was transplanted on one side of 75 cm made ridges keeping plant to plant distance of 30 centimeter on 12.08.15. Standard cultural practices and plant protection measures were adopted. Data regarding curd yield, biomass, average curd weight and plant weight were recorded.

**Table-58 Yield performance of cauliflower hybrids/varieties (2<sup>nd</sup> early) during 2015-16**

S. No.	Entries	Average Plant Weight (kg)	Average Curd Weight (kg)	Biomass (t/ha)	Curd Yield (t/ha )
1	C-002	2.16	0.94	79.40	34.70
2	Advanta-403	1.27	0.81	48.00	30.70
3	Tabinda-F <sub>1</sub>	1.55	0.70	56.00	25.30
4	<b>FD-II (Check)</b>	<b>1.72</b>	<b>0.61</b>	<b>65.50</b>	<b>23.20</b>
	<b>LSD (0.05)</b>			<b>3.75</b>	<b>2.49</b>

The data presented in the table above reveals that the variety C-002 gave highest curd yield of 34.70 t/ha followed by Advanta 403 30.70 t/ha, whereas, the standard variety FD-II gave the lowest curd yield 23.20 t/ha. As for as biomass is concerned C-002 exhibited significantly the highest biomass of 79.40 t/ha followed by FD-II 65.50 t/ha. The lowest biomass was given by Advanta 403 48.00 t/ha. Hybrid C-002 gave the highest average curd weight of 0.94 kg followed by Advanta 403 0.81kg. Hybrid C-002 showed the highest average plant weight 2.16 kg followed by FD-II with 1.72 kg average plant weight.

### 11.2 EVALUATION OF EXOTIC CAULIFLOWER VARIETIES/HYBRIDS SUITABLE FOR MID SEASON IN ADAPTABILITY TRIAL

**Set-I**

Eleven hybrids/varieties including standard variety FD-III were sown for raising the nursery on 10.08.2015 to check their adaptability. Germination of all the varieties was satisfactory. The trial was laid out according to RCB design with three replications keeping plot size of  $7 \times 0.75$ m. Seedlings of all varieties/hybrid were transplanted in the field at a distance of 30 cm on one side of 75 cm made ridges on 23.09.15 in set-I. Standard cultural practices and plant protection measures were carried out regularly. Data regarding curd yield, biomass, average curd weight and plant weight of hybrids/varieties were recorded.

**Table-59 Yield Performance of Cauliflower Hybrid/Varieties during 2015-16 (Mid-season Set-I)**

S. No.	Varieties/hybrid	Average Plant Weight (kg)	Biomass (t/ha)	Average Curd Weight (kg)	Curd Yield (t/ha)
1	White-270	2.78	106.10	1.32	50.30
2	G-CF-1	3.12	118.8	1.28	48.90
3	C-6015	2.05	78.30	1.08	41.40
4	C-7008	1.83	69.70	1.06	40.40
5	C-6041	1.65	63.00	1.02	39.00
6	C-7086	1.94	73.70	1.02	38.90
7	C- 6067	1.80	68.70	0.96	36.70
8	C-6099	1.79	68.20	0.92	35.40
9	White-286	2.13	81.30	0.93	35.40
10	Snow Queen	1.66	63.20	0.90	34.60
11	FD-III	2.63	100.20	0.85	32.70
<b>LSD (0.05)</b>			<b>7.84</b>		<b>3.39</b>

The data presented in table-59 showed that the differences among means due to varieties were significant for curd yield and biomass. The hybrid/variety White-270 gave the highest curd yield 50.30 t/ha closely followed by G-CF-1 48.90 t/ha. The lowest curd yield was given by FD-III 32.70 t/ha. The variety G-CF-1 showed highest biomass 118.8 t/ha followed by White-270 106.10 t/ha and the lowest biomass was given by C-6041 63.00 t/ha. Moreover, variety White-270 gave the highest average curd weight of 1.32 kg followed by G-CF-1 1.28 kg whereas, G-CF-1 showed the highest average plant weight 3.12 kg followed by White-270 with average plant weight of 2.78 kg.

**Set-II**



Twelve hybrids/varieties including standard variety FD-III were sown for raising the nursery on 20.08.2015 to check their adaptability. Germination of all the varieties was satisfactory. The trial was laid out according to RCB design with three replications keeping plot size of 7 × 0.75m. Seedlings of all varieties/hybrid were transplanted in the field at a distance of 30 cm on one side of 75 cm made ridges on 01.10.15 in set-II. Standard cultural practices and plant protection measures were carried out regularly. Data regarding curd yield, biomass, average curd weight and plant weight of hybrids / varieties were recorded.

**Table-60 Yield performance of Cauliflower Hybrid/Varieties during 2015-16 (Mid-Season Set-II)**

S. No.	Varieties/hybrid	Average Plant Weight (kg)	Biomass (t/ha)	Average Curd weight (kg)	Curd Yield (t/ha)
1	ESK-002-F <sub>1</sub>	3.15	120.10	1.89	72.00
2	White Queen	3.33	127.00	1.87	71.40
3	Madhuri-F <sub>1</sub>	3.14	119.80	1.72	65.80
4	White Mountain-F <sub>1</sub>	3.06	116.60	1.64	62.40
5	Greta-F <sub>1</sub>	2.59	98.70	1.37	52.40
6	Remi-F <sub>1</sub>	2.25	85.90	1.35	51.70
7	Siria-F <sub>1</sub>	2.14	81.70	1.14	43.40
8	3570-F <sub>1</sub>	2.23	85.10	1.11	42.53
9	3575-F <sub>1</sub>	1.90	72.60	1.02	38.90
10	White Pearl	2.15	81.90	0.98	37.50
11	B1-F <sub>1</sub>	1.61	61.50	0.85	32.60
12	FD-III	2.14	91.80	0.84	32.10
<b>LSD (0.05)</b>					<b>6.68</b>

The data presented in table-60 reveals that variety/hybrid ESK-002-F<sub>1</sub> exhibited highest curd yield of 72.00 t/ha followed by White Queen which showed curd yield of 71.40 t/ha. The lowest curd yield was given by FD-III 32.10 t/ha. The hybrid White Queen exhibits higher biomass of 127.00 t/ha followed by ESK-002- F<sub>1</sub> 120.10 t/ha. The lowest biomass was given by B1- F<sub>1</sub> 61.50 t/ha. The variety/hybrids ESK-002-F<sub>1</sub> gave the highest average curd weight of 1.89 kg followed by White Queen with average curd weight 1.87 kg. The variety/hybrids White Queen showed the highest average plant weight 3.33 kg followed by ESK-002-F<sub>1</sub> 3.15 kg.

### **11.3 EVALUATION OF EXOTIC CAULIFLOWER VARIETIES/HYBRIDS SUITABLE FOR LATE SEASON IN ADAPTABILITY TRIAL**

**Set-I**

Twelve hybrids/varieties including standard variety FD-IV were sown on 16.09.2015 for raising the nursery to check their adaptability. Germination of all the varieties was satisfactory. The trial was laid out according to RCB design with three replications keeping plot size of 7 × 0.75 m. Seedlings of all varieties/hybrids were transplanted on 20.10.15 in set-I in the field at a distance of 30 cm on one side of 75 cm wide ridges. Standard cultural practices and plant protection measures were carried out regularly. Data regarding curd yield, biomass, average curd weight and plant weight of hybrids/varieties were recorded and presented below.

**Table-61 Yield Performance of Cauliflower Hybrid/Varieties during 2015-16 (Late-Season Set-I)**

S. No.	Varieties/hybrid	Biomass (t/ha)	Average Plant Weight (kg)	Average Curd weight (kg)	Curd Yield (t/ha)
1	Tokyo-F <sub>1</sub>	83.8	2.20	1.41	53.7
2	Iris	91.3	2.40	1.41	53.5
3	Chandni-F <sub>1</sub>	100.5	2.64	1.38	52.4
4	Bushra ACS	87.4	2.29	1.31	49.7
5	Youkon-F <sub>1</sub>	104.6	2.75	1.28	48.6
6	Galaxy-F <sub>1</sub>	98.2	2.58	1.27	48.3
7	Bianca	85.8	2.25	1.25	47.4
8	Kipper ACS	79.7	2.09	1.24	47.4
9	Zoya-F <sub>1</sub>	86.2	2.27	1.24	47.1
10	Kiran-F <sub>1</sub>	80.5	2.11	1.17	44.3
11	Seher-F <sub>1</sub>	84.7	2.23	1.04	39.6
12	<b>FD-IV (Check)</b>	88.1	2.31	0.80	30.5
<b>LSD (0.05)</b>		<b>9.43</b>			<b>7.85</b>

The data presented in table-61 showed that the differences among means due to varieties were significant for curd yield and biomass. The hybrid/variety Tokyo-F<sub>1</sub> gave the highest curd yield 53.7 t/ha closely followed by Iris with yield value of 53.5 t/ha. The lowest curd yield (30.5 t/ha) was given by FD-IV. The hybrid/variety Youkon-F<sub>1</sub> showed

highest biomass 104.6 t/ha followed by Chandni-F<sub>1</sub> with yield value of 100.5 t/ha and the lowest biomass (79.7 t/ha) was given by Kipper ACS. Moreover, varieties Tokyo-F<sub>1</sub> and Iris gave the highest average curd weight of 1.41 kg followed by Chandni-F<sub>1</sub> 1.38 kg whereas, Youkon-F<sub>1</sub> showed the highest average plant weight 2.75 kg followed by Chandni-F<sub>1</sub> with average plant weight of 2.64 kg.

### Set-II

Six hybrids/varieties including standard variety FD-IV were sown on 05.10.2015 for raising the nursery to check their adaptability. Germination of all the varieties was satisfactory. The trial was laid out according to RCB design with three replications keeping plot size of 7 x 0.75 m. Seedlings of all varieties/hybrid were transplanted on 02.11.15 in the field at a distance of 30 cm on one side of 75 cm made ridges in set-II. Standard cultural practices and plant protection measures were carried out regularly. Data regarding curd yield, biomass, average curd weight and plant weight of hybrids/varieties were recorded and presented below.

**Table-62 Yield Performance of Cauliflower Hybrid/Varieties during 2015-16 (Late-Season Set-II)**

S. No.	Varieties/hybrid	Biomass (t/ha)	Average Plant Weight (kg)	Average Curd weight (kg)	Curd Yield (t/ha)
1	Casper-RZ -F <sub>1</sub>	63.6	1.67	0.80	30.5
2	GSL-5054	58.8	1.54	0.70	26.8
3	Bishop-RZ- F <sub>1</sub>	56.4	1.48	0.68	26.2
4	<b>FD-IV (check)</b>	<b>63.9</b>	<b>1.68</b>	<b>0.67</b>	<b>25.8</b>
5	CBS-5055	54.2	1.42	0.63	24.1
6	D-11- F <sub>1</sub>	51.3	1.34	0.58	22.1
	<b>LSD (0.05)</b>	<b>4.93</b>			<b>2.89</b>

The data presented in table-62 reveals that variety/hybrid Casper-RZ-F<sub>1</sub> exhibited highest curd yield of 30.5 t/ha followed by GSL-5054 which showed curd yield of 26.8 t/ha. The lowest curd yield (22.1 t/ha) was given by D-11-F<sub>1</sub>. The variety FD-IV exhibits higher biomass of 63.9 t/ha followed by Casper-RZ-F<sub>1</sub> with biomass yield value of 63.6 t/ha. The lowest biomass was given by D-11-F<sub>1</sub> 51.3 t/ha. The variety/hybrids Casper-RZ

-F<sub>1</sub> gave the highest average curd weight of 0.80 kg followed by Cauliflower-5054 with average curd weight 0.70 kg. The variety FD-IV showed the highest average plant weight of 1.68 kg followed by Casper-RZ -F<sub>1</sub> 1.67 kg.

### Set-III

Eleven hybrids/varieties including standard variety FD-IV were sown on 22.10.2015 for raising the nursery to check their adaptability. Germination of all the varieties was satisfactory. The trial was laid out according to RCB design with three replications keeping plot size of 7 × 0.75 m. Seedlings of all varieties/hybrid were transplanted in the field at a distance of 30 cm on one side of 75 cm made ridges on 03.12.15 in set-III. Standard cultural practices and plant protection measures were carried out regularly. Data regarding curd yield, biomass, average curd weight and plant weight of hybrids/varieties were recorded and presented below.

**Table-63 Yield performance of Cauliflower Hybrid/Varieties during 2015-16 (Late-season Set-III)**

S. No.	Varieties/hybrid	Biomass (t/ha)	Average Plant Weight (kg)	Average Curd weight (kg)	Curd Yield (t/ha)
1	Cauliflower-6201	78.4	2.05	1.06	40.2
2	CKD-961	65.3	1.71	0.96	36.7
3	CKD-872	66.5	1.74	0.92	35.1
4	Rani- F <sub>1</sub>	64.1	1.68	0.87	33.1
5	RS-5340	51.9	1.36	0.80	30.6
6	Hansa	54.6	1.43	0.79	30.1
7	Classic- F <sub>1</sub>	59.9	1.57	0.78	29.6
8	Cauliflower-6199	52.2	1.37	0.73	27.6
9	Whistler	51.5	1.35	0.71	26.9
10	<b>FD-IV (check)</b>	62.1	1.62	0.70	26.6
11	Leo-F <sub>1</sub>	48.0	1.26	0.70	26.5
<b>LSD (0.05)</b>		<b>10.17</b>			<b>5.47</b>

The data presented in table-63 showed that the differences among means due to varieties were significant for curd yield and biomass. The hybrid/variety Cauliflower-

6201 gave the highest curd yield 40.2 t/ha followed by CKD-961 with yield value of 36.7 t/ha. The lowest curd yield (26.5 t/ha) was given by Leo-F<sub>1</sub>. The hybrid/variety Cauliflower-6201 showed highest biomass 78.4 t/ha followed by CKD-872 (66.5 t/ha) and the lowest biomass (48.0 t/ha) was given by Leo-F<sub>1</sub>. Moreover, hybrid/variety Cauliflower-6201 gave the highest average curd weight of 1.06 kg followed by CKD-961 (0.96 kg) whereas Cauliflower-6201 showed the highest average plant weight 2.05 kg followed by CKD-872 with average plant weight of 1.74 kg.

#### Set-IV

Four hybrids/varieties including standard variety FD-IV were sown by direct sowing method on 28.12.2015. Germination of all the varieties was satisfactory. The trial was laid out according to RCB design with three replications keeping plot size of 7 × 0.75m. Sowing was done on one side of 75 cm made ridges by maintaining plant to plant distance of 30 cm. Standard cultural practices and plant protection measures were carried out regularly. Data regarding curd yield, biomass, average curd weight and plant weight of hybrids/varieties were recorded and presented below.

**Table-64 Yield performance of Cauliflower Hybrid/Varieties during 2015-16 (Late-season Set-IV)**

S. No.	Varieties/hybrid	Biomass (t/ha)	Average Plant Weight (kg)	Average Curd weight (kg)	Curd Yield (t/ha)
1	CF-3842	35.74	0.93	0.39	15.08
2	Corona- F <sub>1</sub>	29.89	0.78	0.35	13.46
3	<b>FD-IV (check)</b>	25.19	0.66	0.32	12.16
4	Snow White	27.77	0.73	0.31	11.65
<b>LSD (0.05)</b>		<b>5.96</b>			<b>1.69</b>

The data presented in table-64 showed that the differences among means due to varieties were significant for curd yield and biomass. The hybrid/variety CF-3842 gave the highest curd yield (15.08 t/ha) followed by Corona- F<sub>1</sub> with yield value of 13.46 t/ha. The lowest curd yield (11.65 t/ha) was given by Snow White. The hybrid/variety CF-3842 showed highest biomass 35.74 t/ha followed by Corona- F<sub>1</sub> (29.89 t /ha) and the

lowest biomass (25.19 t/ha) was given by FD-IV. Moreover, hybrid/variety CF-3842 gave the highest average curd weight of 0.39 kg followed by Corona- F<sub>1</sub> (0.35 kg) whereas CF-3842 showed the highest average plant weight 0.93 kg followed by Corona- F<sub>1</sub> with average plant weight of 0.78 kg.

#### 11.4 DEVELOPMENT OF SELF-INCOMPATIBLE INBRED LINES IN FD-II AND FD-III GROUPS OF CAULIFLOWER

The nursery of the varieties was planted according to standard practice and area availability. 30 desirable plants were selected in FD-II and FD-III season cauliflower. 4-5 branches of all the selected plants were selfed normally and through bud pollination. The seed developed in both conditions i.e. normally pollinated as well as bud pollinated flowers. There was not any plant found self-incompatible in FD-II and FD-III cauliflower.

### 12. CABBAGE (*Brassica oleracea* Var. *capitata*)

#### 12.1 EVALUATION OF EXOTIC CABBAGE VARIETIES/HYBRIDS (SET-I)

Eight hybrids/varieties viz; Cabbage No-1, Roshan-F<sub>1</sub>, Green Stone, G-CB-1, Vaneza-F<sub>1</sub>, Ever Green-F<sub>1</sub>, Delight Ball and T-138 were sown in nursery on 16.09.2015. Germination of all the varieties was satisfactory and was transplanted in the field on 20.10. 2015 in RCB Design with three replications in a plot size of 7×0.75m. Transplanting was done by keeping plant to plant and row to row distances of 30 cm and 75 cm, respectively. Standard cultural practices and plant protection measures were adopted. Data regarding head yield, biomass, average head weight and average plant weight were recorded.

**Table-65 Yield Performance of Cabbage Hybrids/Varieties during 2015-16 (Set-I)**

S. No.	Varieties/hybrid	Biomass (t/ha)	Average Plant Weight (kg)	Average Head weight (kg)	Head Yield (t/ha)
1	Delight Ball	57.9	1.52	1.07	40.7
2	Vaneza-F <sub>1</sub>	54.4	1.43	1.04	39.8
3	G-CB-1	56.5	1.48	1.03	39.2
4	Green Stone	58.9	1.54	1.00	38.2
5	Roshan-F <sub>1</sub>	58.9	1.54	0.96	36.7
6	Cabbage No-1	59.0	1.55	0.96	36.4

7	Ever Green-F <sub>1</sub>	54.4	1.43	0.90	34.2
8	T-138	41.5	1.08	0.78	29.7
<b>LSD (0.05)</b>		<b>6.1</b>			<b>3.7</b>

The data presented in table-65 depicted that the hybrid/variety Delight Ball gave the highest head yield 40.7 t/ha followed by Vaneza-F<sub>1</sub> 39.8 t/ha whereas, the lowest head yield was given by variety T-138 29.7 t/ha. In case of biomass variety/hybrids Cabbage No-1 showed the highest biomass of 59.0 t/ha followed by Roshan-F<sub>1</sub> and Green Stone 58.9 t/ha, whereas, the lowest biomass was produced by variety T-138 41.5 t/ha. The hybrid/variety Delight Ball gave highest average head weight of 1.07 kg followed by Vaneza-F<sub>1</sub> 1.04 kg. In case of average plant weight Cabbage No-1 showed the highest average plant weight (1.55 kg) followed by Green Stone and Roshan-F<sub>1</sub> with average plant weight of 1.54kg.

#### Set-II

Three hybrids/varieties viz; GSL-1198, CBS-222 and Roshan-F<sub>1</sub> were sown in nursery on 07.10.2015. Germination of all the varieties was satisfactory and was transplanted in the field on 04.11.2015 in RCB Design with four replications in a plot size of 7 × 0.75m. Transplanting was done by keeping plant to plant and row to row distances of 30 cm and 75 cm, respectively. Standard cultural practices and plant protection measures were adopted. Data regarding head yield, biomass, average head weight and average plant weight were recorded.

**Table-66 Yield performance of Cabbage Hybrids/Varieties during 2015-16 (Set-II)**

S. No.	Varieties/hybrid	Biomass (t/ha)	Average Plant Weight (kg)	Average Head weight (kg)	Head Yield (t/ha)
1	Roshan-F <sub>1</sub>	57.93	1.52	1.02	38.74
2	CBS-222	51.43	1.35	0.89	33.84
3	GSL-1198	51.40	1.35	0.85	32.64
<b>LSD (0.05)</b>		<b>7.0</b>			<b>4.4</b>

The data presented in table-66 depicted that the hybrid/variety Roshan-F<sub>1</sub> gave the highest head yield 38.74 t/ha followed by CBS-222 33.84 t/ha whereas, the lowest head yield

was given by hybrid/variety GSL-1198 32.64 t/ha. In case of biomass variety/hybrids Roshan-F<sub>1</sub> showed the highest biomass of 57.93 t/ha followed by CBS-222 51.43 t/ha, whereas, the lowest biomass was produced by hybrid/variety GSL-1198 51.40 t/ha. The hybrid/variety Roshan-F<sub>1</sub> gave highest average head weight of 1.02 kg followed by CBS-222 0.89 kg. In case of average plant weight Roshan-F<sub>1</sub> showed the highest average plant weight 1.52 kg followed by CBS-222 and GSL-1198 with average plant weight of 1.35kg.

### Set-III

Four hybrids/varieties viz; Beauty Ball, Tropicana, Saint and Blue Dynsty were sown in nursery on 22.10.2015. Germination of all the varieties was satisfactory and were transplanted in the field on 20.11.2015 in RCB Design with four replications in a plot size of 7m × 0.75m. Transplanting was done by keeping plant to plant and row to row distances of 30 cm and 75 cm, respectively. Standard cultural practices and plant protection measures were adopted. Data regarding head yield, biomass, average head weight and average plant weight were recorded.

**Table-67 Yield performance of Cabbage Hybrids/Varieties during 2015-16 (Set-III)**

S. No.	Varieties/hybrid	Biomass (t/ha)	Average Plant Weight (kg)	Average Head weight (kg)	Head Yield (t/ha)
1	Tropicana	75.1	1.97	1.27	48.2
2	Beauty Ball	62.4	1.64	1.17	44.6
3	Saint	60.2	1.58	1.07	40.5
4	Blue Dynsty	66.0	1.74	1.00	38.1
	<b>LSD (0.05)</b>	<b>14.5</b>			<b>9.9</b>

The data presented in table-67 depicted that the hybrid/variety Tropicana gave the highest head yield (48.2 t/ha) followed by Beauty Ball 44.6 t/ha whereas, the lowest head yield was given by hybrid/variety Blue Dynsty 38.1 t/ha. In case of biomass variety/hybrids Tropicana showed the highest biomass of 75.1 t/ha followed by Blue Dynsty 66.0 t/ha, whereas, the lowest biomass was produced by hybrid/variety Saint 60.2 t/ha. The hybrid / variety Tropicana gave highest average head weight of 1.27 kg followed by Beauty Ball 1.17 kg. In case of average plant weight Tropicana showed the highest average plant weight 1.97 kg followed by Blue Dynsty with average plant weight of 1.74kg.



**Set-IV**

6 hybrids/varieties viz; Roca- F<sub>1</sub>, Red Ball-F<sub>1</sub>, Marco-F<sub>1</sub>, Austin-F<sub>1</sub>, Unikat and Glacier were sown by direct sowing method on 28.12.2015. Germination of all the varieties was satisfactory. The trial was laid out according to RCB design with three replications keeping plot size of 7 × 0.75m. Sowing was done on one side of 75 cm made ridges by maintaining plant-plant distance of 30 cm. Standard cultural practices and plant protection measures were carried out regularly. Standard cultural practices and plant protection measures were adopted. Data regarding head yield, biomass, average head weight and average plant weight were recorded.

**Table-68 Yield Performance of Cabbage Hybrids/Varieties Set-IV during 2015-16**

S. No.	Variety/hybrid	Biomass (t/ha)	Average Plant Weight (kg)	Average Head weight (kg)	Head Yield (t/ha)
1	Austin-F <sub>1</sub>	34.10	0.89	0.56	21.18
2	Unikat	33.05	0.87	0.47	17.78
3	Marco-F <sub>1</sub>	30.71	0.81	0.41	15.51
4	Roca-F <sub>1</sub>	28.06	0.74	0.39	14.77
5	Glacier	23.31	0.61	0.36	13.89
6	Red Ball-F <sub>1</sub>	26.55	0.70	0.35	13.45
<b>LSD (0.05)</b>		<b>6.9</b>			<b>2.40</b>

The data presented in table-68 depicted that the hybrid/variety Austin-F<sub>1</sub> gave the highest head yield 21.18 t/ha followed by Unikat 17.78 t/ha whereas, the lowest head yield was given by hybrid Red Ball- F<sub>1</sub> 13.45 t/ha. In case of biomass variety/hybrids Austin-F<sub>1</sub> showed the highest biomass of 34.10 t/ha followed by Unikat 33.05 t/ha, whereas, the lowest biomass was produced by hybrid/variety Glacier 23.31 t/ha. The hybrid/variety Austin-F<sub>1</sub> gave highest average head weight of 0.56 kg followed by Unikat 0.47 kg. In case of average plant weight Austin- F<sub>1</sub> showed the highest average plant weight 0.89 kg followed by Unikat with average plant weight of 0.87 kg.

**13. Broccoli (*Brassica oleracea* var. *italica*)****13.1 EVALUATION OF EXOTIC BROCOLLI VARIETIES / HYBRIDS****Set-I**

Three hybrids/varieties Green Pia, 06B600 and Baro Star were sown in nursery on 16.09.2015. Germination of all the varieties was satisfactory and were transplanted in the field on 20.10.2015 in RCB Design with three replications in a plot size of 7 × 1.5 m. Transplanting was done by keeping plant to plant and row to row distances of 30 cm and 75 cm, respectively. Standard cultural practices and plant protection measures were adopted. Data regarding head yield was recorded.

**Table-69 Yield Performance of Broccoli Hybrid/Varieties during 2015-16 (Set-I)**

S. No.	Varieties/hybrid	Head Yield (t/ha)
1	Green Pia	16.7
2	06B600	13.8
3	Baro Star	12.1
<b>LSD (0.05)</b>		<b>2.34</b>

The data presented in the table-69 depicted that the hybrid/variety Green Pia gave the highest head yield 16.7 t/ha followed by 06B600 13.8 t/ha whereas, the lowest head yield was given by variety Baro Star 12.1 t/ha.

### **Set-II**

Three hybrids/varieties Green Pia, Baro Star and Paraiso were sown in nursery on 22.10.2015. Germination of all the varieties was satisfactory and were transplanted in the field on 20.11.2015 in RCB Design with three replications in a plot size of 7 × 1.5m. Transplanting was done by keeping plant to plant and row to row distances of 30 cm and 75 cm, respectively. Standard cultural practices and plant protection measures were adopted. Data regarding head yield was recorded.

**Table-70 Yield Performance of Broccoli Hybrid/Varieties during 2015-16 (Set-II)**

S. No.	Varieties/hybrid	Head Yield (t/ha)
1	Paraiso	14.9
2	Green Pia	13.6
3	Baro Star	11.5
<b>LSD (0.05)</b>		<b>4.31</b>

The data presented in the table-70 depicted that the hybrid/variety Paraiso gave the highest head yield (14.9 t/ha) followed by Green Pia 13.6 t/ha whereas, the lowest head yield was given by variety Baro Star (11.5 t/ha)

## **14 ONION (*Allium cepa*)**

### **14.1 DEVELOPMENT OF ONION INBRED LINES**

The sets of three varieties i.e. Ceylon, Red Moon and Desi Red were planted during August 2015 and were re-planted during December 2015 keeping row to row and plant to plant distance of 75 and 30 cm, respectively. Twenty five umbels from each variety were covered with bags prior to flower opening. The covered umbels were shaken daily till the opening of the flowers.  $S_1$  seed of these varieties were collected on maturity for further studies in the next generation.

$S_1$  Seed of three varieties i.e. Desi Red, red moon and Ceylon produced during the previous year was sown during October 2015 for nursery sets production of generation  $S_2$  and sets were harvested during May 2016.

The  $S_2$  sets of six varieties i.e. Red Imposta, Robina, Mirpur Khas, Selection-I and Selection-IV and Faisal Red were produced from nursery setts during August 2015 and were planted during December 2015 keeping row to row and plant to plant distance of 75 and 30 cm, respectively for selfing. Twenty five umbels from each variety were covered with bags prior to flower opening. The covered umbels were shaken daily till the opening of the flowers. So  $S_3$  seed of these varieties was collected on maturity for further studies in the next generation.

$S_3$  Seed of two varieties i.e. Desi Red and NOH-1069 produced during the previous year was sown during October 2014 for nursery sets production of generation  $S_4$  and sets were harvested during May 2015 and planted in August 2015 and then replanted during December 2015 keeping row to row and plant to plant distance of 75 and 30 cm, respectively for selfing. Twenty five umbels from each variety were covered with bags prior to flower opening. The covered umbels were shaken daily till the opening of the flowers. Seed of  $S_4$  generation was collected for further studies.

$S_4$  Sets of one variety 4466 were planted in August 2015 and then replanted during December 2015 keeping row to row and plant to plant distance of 75 and 30 cm, respectively for selfing. Twenty five umbels were covered with bags prior to flower

opening. The covered umbels were shaken daily till the opening of the flowers. Seed of S<sub>5</sub> generation was collected for further studies.

#### **14.2 EXOTIC VARIETIES/HYBRID IN ADAPTABILITY TRIAL CONDUCTED AT VEGETABLE RESEARCH INSTITUTE, FAISALABAD DURING RABI SEASON 2015-16 SET-I**

Thirteen varieties/hybrid received from different seed companies were tested along with check (Phulkara) for their performance in adaptability trial at vegetable research institute, Faisalabad during Rabi season 2015. The nursery was sown on 21.10.2015 and transplanted on 6.01.2016 in the field according to Randomized Complete Block Design with three replications. The plot size was kept as 7 × 1.5 m. Thirteen onion cultivars along with check Phulkara were transplanted on both sides of 75 cm apart ridges with 10 cm plant to plant distance within row. All agronomic and plant protection measures were adopted to maintain the crop. Crop harvesting was done on 19.05.2016 and data regarding onion bulb yield, plant weight, bulb weight, neck diameter, bulb diameter and number of rings per bulb were recorded and presented in the following table.71

**Table-71 Yield performance of Exotic Onion Varieties/Hybrids in Adaptability Trial conducted at VRI, Faisalabad**

<b>Varieties</b>	<b>Plant Weight (g)</b>	<b>Bulb Weight (g)</b>	<b>Neck Diameter (cm)</b>	<b>Bulb Diameter (cm)</b>	<b>No. of rings/ bulb</b>	<b>Yield (t/ha)</b>
Ruby F <sub>1</sub>	59.00	62.67	0.92	4.87	6.73	3.56
Red Moon	66.00	67.33	1.07	5.37	6.27	7.51
Robin F <sub>1</sub>	71.00	68.67	0.97	5.14	7.00	6.94
Hybrid Onion Kareem	68.67	63.67	1.13	5.11	9.07	4.62
Red Snack	63.67	61.00	1.03	5.49	6.67	4.87
Premium F <sub>1</sub>	73.33	67.67	0.79	5.39	7.43	2.87
Islero F <sub>1</sub>	55.33	57.33	0.99	5.01	6.67	3.46
Red King	76.67	74.67	1.05	5.67	7.13	8.10
Spice Onion (Barkeel)	55.00	55.00	0.71	5.01	7.00	4.52
SV0748NP*	53.33	47.00	0.69	4.76	6.60	4.44
Monica	79.33	77.33	0.92	5.50	7.60	7.24
SV1695NP*	56.67	52.67	0.95	4.51	7.10	2.98
ICI 1801 F <sub>1</sub>	63.67	61.00	0.78	5.05	7.27	4.77
<b>Phulkara (check)</b>	63.67	68.67	0.94	5.53	7.47	4.88

<b>LSD (0.05)</b>	<b>0.51</b>	<b>0.48</b>	<b>0.14</b>	<b>0.63</b>	<b>0.86</b>	<b>1.18</b>
-------------------	-------------	-------------	-------------	-------------	-------------	-------------

The data presented in the table-72 reveals that differences among means due to varieties were significant for yield. Top four ranked entries namely Red King (8.10 t/ha), Red Moon (7.51 t/ha), Monica (7.24 t/ha) and Robin F<sub>1</sub> (6.94 t/ha) produced significantly higher yield than check Phulkara (4.88 t/ha). The lowest fruit yield was recorded in the entry Premium F<sub>1</sub> (2.87 t/ha).

### **SET-II**

Five varieties/hybrids received from different seed companies were tested along with check (Phulkara) for their performance in adaptability trial at vegetable research institute, Faisalabad during Rabi season 2015-16. The nursery was sown on 09.11.2015 and transplanted on 04.02.2016 in the field according to Randomized Complete Block Design with three replications. The plot size was kept as 7 × 1.5 m. Five onion cultivars i.e. KQS-HON-1, Prema, CBS-130, GSL-132, Rain Gold and Phulkara (check) were transplanted on both sides of 70 cm apart ridges with 10 cm plant to plant distance within row. All agronomic and plant protection measures were adopted to maintain the crop. Crop harvesting was done on 19.05.2016 and data regarding onion bulb yield, plant weight, bulb weight, neck diameter, bulb diameter and number of rings per bulb were recorded and presented in the following table 72.

**Table-72 Yield Performance of Exotic Onion Varieties/Hybrids in Adaptability Trial conducted at VRI, Faisalabad**

<b>Varieties</b>	<b>Plant Weight (g)</b>	<b>Bulb Weight (g)</b>	<b>Neck Diameter (cm)</b>	<b>Bulb Diameter (cm)</b>	<b>No. of rings/bulb</b>	<b>Yield (t/ha)</b>
KQS-HON-1	23.00	20.67	0.93	3.34	6.60	3.31
Prema	20.00	18.67	0.83	3.44	6.27	3.76
CBS-130	13.00	13.50	0.72	2.66	5.73	3.00
GSL-132	5.00	4.50	0.34	1.77	4.20	3.24
Rain Gold	10.00	8.83	0.70	2.57	5.87	3.13
<b>Phulkara (check)</b>	<b>22.00</b>	<b>19.50</b>	<b>0.88</b>	<b>3.74</b>	<b>7.13</b>	<b>3.36</b>

<b>LSD(0.05)</b>	<b>0.61</b>	<b>1.08</b>	<b>0.36</b>	<b>0.91</b>	<b>0.99</b>	<b>0.38</b>
------------------	-------------	-------------	-------------	-------------	-------------	-------------

The data presented in the table reveals that difference among means due to varieties were significant for yield. Variety Prema showed significantly high yield (3.76 t/ha) than Phulkara check (3.36 t/ha) and CBS-130 produced lowest yield (3 t/ha).

### 14.3 EVALUATION OF ONION VARIETIES FOR SPRING SEASON

The nursery of 19 varieties including check variety Phulkara were sown on 3.11.2015 and transplanting was done on 11.1.2016 in Randomized Complete Block Design with three replications. Transplanting was done on both sides of the ridges made 75 cm apart keeping plant to plant distance of 10 cm. The data regarding yield and other characters was recorded at maturity on 19-5-2016 and is presented in the following Table.

**Table-73 Performance of Onion Genotypes during Spring Season 2015-16**

<b>Entries</b>	<b>Plant Weight (g)</b>	<b>Bulb Weight (g)</b>	<b>Bulb Diameter (cm)</b>	<b>Neck Diameter (cm)</b>	<b>No. of rings/ Bulb</b>	<b>Yield (t/ha)</b>
VRIO-1	36.40	12.13	4.37	0.91	6.60	10.22
VRIO-2	53.73	17.91	5.03	0.92	6.80	11.66
VRIO-3	10.80	3.60	2.46	0.59	5.47	11.19
VRIO-4	34.27	11.42	4.19	0.95	6.67	10.05
VRIO-5	41.87	13.96	4.34	0.68	6.47	11.09
VRIO-6	31.73	10.58	3.91	0.83	6.80	12.50
VRIO-7	44.67	14.89	4.63	0.96	6.87	10.57
VRIO-8	53.87	17.96	4.87	0.93	7.13	12.24
<b>Phulkara (check)</b>	<b>36.93</b>	<b>12.31</b>	<b>4.17</b>	<b>0.84</b>	<b>6.47</b>	<b>10.68</b>
Dark Red	34.00	11.33	4.14	0.93	6.67	10.68
Red Nasic	42.53	14.18	4.58	0.93	7.27	11.84
Desi Large	51.53	17.18	4.85	1.07	7.07	11.58

Red Imposta	42.53	14.18	4.67	0.93	7.13	11.34
Early Red	46.93	15.64	4.75	0.94	7.20	11.05
Robina	39.20	13.07	4.29	0.85	7.07	9.47
Desi Red	32.67	10.89	4.02	0.78	6.20	9.49
PK-10321	36.93	12.31	4.29	0.87	7.13	10.13
Pusa Red	41.73	13.91	4.47	0.91	6.93	9.98
M.P Khas	41.20	13.73	4.49	0.79	6.87	10.84
<b>LSD(0.05)</b>	<b>2.65</b>	<b>1.65</b>	<b>0.56</b>	<b>0.25</b>	<b>1.02</b>	<b>2.01</b>

The differences among varieties/strains in yield are statistically significant. The variety VRIO-6 secured first position by producing bulb yield 12.50 t/ha which was followed by the varieties VRIO-8 (12.24 t/ha) and Red Nasic (11.84 t/ha).

## 15. OKRA (*Abelmoschus esculentus*)

### 15.1 MAINTENANCE OF GERMPLASM

Germplasm comprising of 38 lines/varieties of okra viz; OK-1301, OK-1302, OK-1303, OK-1304, OK-1305, OK-1307, OK-1308, OK-1309, OK-1310, OK-1312, OK-1313, OK-1315, OK-1316, China red, Ikra, Pen Beauty, Green wonder, Anarkali, Sanum, Parbhani karanti, Punjab Selection, Arka Anamika, Pusa Swani, Sabz pari, Kiran, Kashish, OK-2015, OH-713, OK-1501, OK-1502, OK-1503, OK-1504, OK-1505, OK-1506, OK-1507, OK-1508, OK-1509, OK-1510 were sown on 26-02-2016 to maintain the genetic purity and to utilize in future breeding program. Sowing was done on one side of 75 cm wide ridges by keeping plant to plant distance of 30 cm. Selfed and matured fruits of true to type plants in each genotype were harvested separately, for further use in future breeding programme. Range of different traits in available germplasm is given in the Table.

**Table-74 Range of different Morphological Traits in okra Lines/Varieties**

S. No	Traits	Minimum	Maximum
1.	Days to 1 <sup>st</sup> Flower initiation	35	45
2.	Inter-nodal length (cm)	2.5	5.0
3.	Pod Length (cm)	13	18

4.	Pod Width (cm)	1.6	2.2
5.	Beak length (cm)	2.5	3.5

## 15.2 HYBRIDIZATION

To develop high yielding and disease tolerant okra varieties, two female lines and four male parents were sown on 26-02-2016 in crossing block to create genetic variability for further studies. Crosses were attempted to produce F<sub>1</sub> hybrids. The detail of successful cross combinations is shown in table below.

**Table-75 List of okra crosses (F<sub>0</sub>) made during February, 2016**

S. No.	Name of Cross
1	Sanum × OK-1313
2	Sanum × OK-1314
3	Sanum × Kashish
4	OK-1312 × China Red
5	OK-1313 × Kashish
6	OK-1312 × Kashish
7	OK-1314 × Kashish
8	OK-1314 × OK-1312

## 15.2 STUDY OF FILIALS

Filial generations were sown on one side of 75cm wide ridge by keeping plant to plant distance of 30 cm 26-02-2016. Standard agronomic and plant protection measures were adopted to raise the crop. All crosses germinated normally. From each population healthy plants were selected on the basis of disease tolerance, number of fruits and fruit shape. At maturity, ripened fruits from segregating generations were harvested and seeds were collected for next year sowing to advance the generation. The desired progenies/ lines were selected and the detail of generation is given below:

**Table-76 Study/ Selection of Progenies from Filials**

S. No.	Cross
<b>F<sub>1</sub> Generations</b>	
1	Ikra × Sabz Pari
2	Sabz Pari × Sukhlai
3	Parbhani Karanti × OK-1313



4	Parbhani Karanti × OK-1314
5	OK-1313 × Ikra
6	OK-1314 × Sukhlai
7	OK-1313 × OK-152
8	Parbhani Karanti × Sukhlai
<b>F<sub>2</sub> Generations</b>	
1	Sabz Pari × OK-1313
2	Sabz Pari × OK-1314
3	OK-1312 × OK-1313
4	OK-1313 × OK-1312
5	OK-1314 × OK-1312
<b>F<sub>3</sub> Generations</b>	
1	Pusa swani × Anarkali
2	Pusa swani × Arka anamika
3	Pusa swani × Parbhani karanti
4	Punjab selection × Anarkali
5	Punjab selection × Arka anamika
6	Punjab selection × Parbhani karanti
7	Sanum × Anarkali
8	Sanum × Arka anamika
9	Sanum × Parbhani karanti
10	Ikra × Anarkali
11	Ikra × Arka anamika
12	Ikra × Parbhani karanti

#### **15.4 EVALUATION OF OKRA HYBRIDS/VARIETIES IN ADAPTABILITY TRIAL**

Twelve exotic varieties/hybrids imported by seed companies were tested to check their adaptability against the check variety “Sabz Pari”. The trial was sown in the field according to Randomized Complete Block Design with three replications keeping plot size of 7 × 1.5 m on 25-02-2016. Sowing was done on both sides of ridge keeping plant to plant distance of 10 cm and row to row distance of 75 cm. Standard agronomic practices and plant protection measures were adopted when needed. Fresh marketable fruit picking was started on 20-04-2016 and continued till 27-06-2016. Data regarding fresh fruit yield were recorded and showed in the following table.

**Table-77 Yield performance of exotic okra hybrids/varieties in adaptability trial conducted at VRI Faisalabad during kharif, 2016**

S. No.	Variety	Fresh fruit yield (t/ha)
1.	Mahy-64	14.02
2.	Rohi F <sub>1</sub>	13.87
3.	Mornee F <sub>1</sub>	12.82
4.	Nayab	12.06
5.	KHO-1	11.34
6.	Guard Karishma	10.79
7.	OK-407	10.65
8.	Marvi AB	10.28
9.	Sureeli F <sub>1</sub>	9.99
<b>10.</b>	<b>Sabz Pari (check)</b>	<b>9.90</b>
11.	Shabnum F <sub>1</sub>	9.46
12.	Malka F <sub>1</sub>	7.18
13.	Silky-460	0.07
	<b>LSD(0.05)</b>	<b>1.64</b>

The data presented in the above table shows that difference among means due to varieties were significant for fresh fruit yield. The four varieties/hybrids Mahy-64, Rohi F<sub>1</sub>, Mornee F<sub>1</sub>, Nayab performed better against check Sabz pari. The lowest yield was recorded in exotic entry silky-460 (0.07t/ha).

#### **SET-II**

Thirteen exotic varieties/hybrids imported by seed companies were tested to check their adaptability against the check variety “Sabz Pari”. The trial was sown in the field according to Randomized Complete Block Design with three replications keeping plot size of 7 × 1.5 m on 25-02-2016. Sowing was done on both sides of ridge keeping plant to plant distance of 10 cm and row to row distance of 75 cm. All varieties germinated normally and all agronomic practices and plant protection measures were adopted when needed. Fresh marketable fruit picking was started on 20-04-2016 and continued till 27-06-2016. Data regarding fresh fruit yield were recorded and showed in the following table.

**Table-78 Yield performance of exotic okra hybrids/varieties in adaptability trial conducted at VRI Faisalabad during kharif, 2016 (Set-II)**

S. No.	Variety	Fresh fruit yield (t/ha)
1.	G-HO-1	16.58
2.	Lakshmi F <sub>1</sub>	14.65
3.	Okra-669	14.10
4.	OK-408	13.53
5.	ASOK 49-82	13.44
6.	Suraksha F <sub>1</sub>	12.89
7.	HO-041B	12.88
8.	Softo	12.68
9.	Raksha F <sub>1</sub>	12.65
10.	Green Star F <sub>1</sub>	12.28
11.	Rosham F <sub>1</sub>	11.81
12.	Rupa F <sub>1</sub>	11.72
<b>13.</b>	<b>Sabz Pari (check)</b>	<b>11.69</b>
14.	Resham	11.54
<b>LSD(0.05)</b>		<b>1.67</b>

The data presented in the above table shows that difference among means due to varieties were significant for fresh fruit yield. Five varieties/hybrids G-HO-1, Lakshmi F<sub>1</sub>, Okra-669, OK-408 and ASOK 49-82 with fruit yield range of 16.58 to 13.44 t/ha gave significant higher fresh fruit yield than standard variety Sabz Pari (11.69 t/ha).

## **16 SPONGE GOURD (*Lufa cylindrica*)**

### **16.1 MAINTENANCE OF SPONGE GOURD GERMPLASM**

To maintain germplasm for further utilization in breeding program, ten sponge gourd genotypes were sown on 10-03-2016 in a plot size of 6.1 × 3.2 m keeping plant to plant distance of 50 cm. Germination of all the entries was good. Each genotype was maintained through sib mating and seed was collected separately.

### **16.2 DEVELOPMENT OF INBRED LINES IN SPONGE GOURD**

To develop inbred lines for the development of hybrids/composite varieties, the seed of S<sub>0</sub>, S<sub>1</sub> and S<sub>2</sub> were sown during 1<sup>st</sup> week of March, 2016 on both sides of 4 meter wide beds keeping plant to plant distance of 50 cm. 10 flowers on 3-4 selected plants in each bed were selfed to get at least one mature fruit for generation advancement. At maturity, selfed seed was collected, separately for further studies.

### 16.3 REPORT ON EXOTIC VARIETIES/HYBRIDS OF SPONGE GOURD IN ADAPTABILITY TRIAL CONDUCTED AT VEGETABLE RESEARCH INSTITUTE, FAISALABAD DURING KHARIF SEASON 2016

Fourteen exotic varieties/hybrids along with local check of sponge gourd were sown in adaptability trial at Vegetable Research Institute, Faisalabad on 4-03-2016 to evaluate their yield performance. The layout was RCBD having three replications with a plot size of 6 × 3 m and plant to plant distance of 45 cm. Germination of all the entries was more than 90%. All agronomic and plant protection measures were applied to maintain growth of the crop. Fresh fruit pickings were started on 26-04-2016 and continued till 21-9-2016. Data regarding fruit yield were recorded from 57 pickings that are presented in table below.

**Table-79 Yield performance of Sponge Gourd Varieties/Hybrids in Adaptability Trial conducted at VRI during Kharif, 2016**

<b>Rank</b>	<b>Variety/ Hybrid</b>	<b>Fruit Yield (t/ha)</b>
1	Advanta F <sub>1</sub> 1102	24.91
2	Advanta F <sub>1</sub> 1101	18.02
3	ASSP-65-90	17.78
4	All Green F <sub>1</sub> NSC	17.70
5	Mira F <sub>1</sub> (Black)	17.55
6	Sarina F <sub>1</sub>	16.20
7	All Green F <sub>1</sub> (Chia)	16.06
8	Kohinoor F <sub>1</sub>	15.61
9	Lasani F <sub>1</sub>	15.51
10	Kiran F <sub>1</sub>	14.81
11	Star -555 F <sub>1</sub>	14.74
12	White Pari AB	14.30
13	Green Pari AB	13.90
14	<b>Local (check)</b>	<b>13.12</b>
15	Anmol F <sub>1</sub>	10.98
<b>LSD (0.05)</b>		<b>3.46</b>

The data presented in the above table reveals that the differences among means due to varieties were significant for fresh fruit yield. Five varieties/hybrids *viz*: Advanta 1102 F<sub>1</sub>, Advanta 1101 F<sub>1</sub>, ASSP-65-90, All Green F<sub>1</sub> and Mira F<sub>1</sub> (Black) with fruit yield (24.91, 18.02, 17.78, 17.70 and 17.55 t/ha) respectively gave significantly higher fresh fruit yield than standard variety local check (13.12 t/ha). Whereas Anmol F<sub>1</sub> with fruit yield 10.98 t/ha gave lower fruit yield against the standard variety.

#### **16.4 REPORT ON EXOTIC VARIETIES/HYBRIDS OF RIDGE GOURD IN ADAPTABILITY TRIAL CONDUCTED AT VEGETABLE RESEARCH INSTITUTE, FAISALABAD DURING KHARIF SEASON 2016**

Eleven exotic varieties/hybrids of ridge gourd along with “Local” check of sponge gourd were sown in adaptability trial at Vegetable Research Institute, Faisalabad on 04-03-2016 to evaluate their yield performance. The layout was RCBD having three replications with a plot size of 6 × 3 m and plant to plant distance of 45 cm. Germination of all the entries was more than 90%. All agronomic and plant protection measures were followed to maintain growth of the crop. Fresh fruit pickings were started on 26-04-2016 and continued till 29-06-2016. Data regarding fruit yield were recorded from 26 pickings that are presented in table below.

**Table-80 Yield performance of Ridge Gourd Varieties/Hybrids in Adaptability Trial conducted at VRI during Kharif, 2016**

<b>Rank</b>	<b>Variety/ Hybrid</b>	<b>Fruit Yield (t/ha)</b>
1	Advanta F <sub>1</sub> 1602	7.67
2	Mayuri F <sub>1</sub>	6.84
3	Anmol F <sub>1</sub>	5.46
4	<b>Local (check)</b>	<b>5.16</b>
5	Mala F <sub>1</sub>	4.91
6	Gagan F <sub>1</sub>	4.81
7	Dargai F <sub>1</sub>	4.32
8	Star-225 F <sub>1</sub>	4.02
9	Advanta F <sub>1</sub> 1601	3.74
10	Queen F <sub>1</sub>	3.26

11	Karina F <sub>1</sub>	2.40
12	Benazir 246 F <sub>1</sub>	1.97
<b>LSD (0.05)</b>		<b>1.62</b>

The data presented in the above table revealed that the differences among means due to varieties were significant for fresh fruit yield. Two varieties/hybrids *viz*; Advanta 1102 F<sub>1</sub> and Mayuri F<sub>1</sub> with fruit yield (7.67 and 6.84t/ha) respectively gave significantly higher fresh fruit yield than standard variety i.e. local check (5.16 t/ha). Whereas remaining eight varieties gave lower fruit yield against the standard variety.

## **17 CUCUMBER (*Cucumis sativus*)**

### **17.1 ADAPTABILITY TRIAL ON CUCUMBER IN OPEN FIELD**

Thirty nine variety/hybrids of cucumber were tested at Vegetable Research Institute, Faisalabad in open field during Kharif 2016. Due to huge number of entries it is difficult to manage the whole material in one trial so these entries were tested in four sets. Ten cucumber varieties/hybrids namely Florus F<sub>1</sub>, Hady F<sub>1</sub>, Raneem F<sub>1</sub>, Hoosier F<sub>1</sub>, CU-971, MDS-13-CU-5757, MDS-12-CU-5513, MDS-INX-732, Badshah, Messi F<sub>1</sub> and Local (Check) were sown in Set-I. Eleven cucumber varieties/hybrids namely Alpha Prime, Safaa, Thamin-II, Liza, Saram F<sub>1</sub>, Jarrar F<sub>1</sub>, CU-4562, Dinar F<sub>1</sub>, Advanta F<sub>1</sub> 701, Advanta F<sub>1</sub> 702, Asian-I and Local (Check) were sown in Set-II. Eleven cucumber varieties/hybrids namely Porto F<sub>1</sub>, Vella F<sub>1</sub>, Spider F<sub>1</sub>, Zoro F<sub>1</sub>, Tiger 990 F<sub>1</sub>, Dania 730 F<sub>1</sub>, Vareene F<sub>1</sub>, Chaman F<sub>1</sub>, Falcon F<sub>1</sub>, Indus F<sub>1</sub>, Karizma and Local (Check) were sown in Set-III. Seven cucumber varieties/hybrids namely 227-G F<sub>1</sub>, Lina F<sub>1</sub>, Target Karina, Kalaam F<sub>1</sub>, Sunshine F<sub>1</sub>, Proton F<sub>1</sub>, Honey AB and Local (Check) were sown in Set-IV in open field on March 04, 2016. Some seeds from different varieties have not germinated. To assure optimum crop stand re-sowing was done of those varieties whose germination was not up to mark in first sowing. The trials were laid out according to randomized complete block design (RCBD) with three replications. Plot size was maintained as 6 × 2.5 m with three replications and plant to plant distance was kept as 30 cm. Fruits picking was started on April 18, 2016 and lasted up to May 30, 2016. In total, thirteen pickings were taken from the trial. During 2<sup>nd</sup> week of April severe attack of downy

mildew was recorded and remedial measures were adopted to overcome the disease but the results were not appreciable. High temperature during second fortnight of May badly damaged the vines of cucumber which resulted in to termination of crop. Data regarding germination %age, No. of fruits/plant, fruit yield (t/ha) were recorded and analyzed statistically which are presented in the following tables.

**Table-81 Performance of Cucumber hybrids/varieties in an adaptability trial at Vegetable Research Institute, Faisalabad during Kharif 2016 (Set-I)**

S. No.	Varieties	Germination %	No. of fruits/plant	Fruit yield (t/ha)
1	Local (Check)	75.6	4.6	17.1
2	Badshah	77.8	8.7	16.5
3	Messi F <sub>1</sub>	76.7	7.6	15.3
4	Florus F <sub>1</sub>	76.7	5.6	10.2
5	Hoosier F <sub>1</sub>	82.2	6.4	8.9
6	CU-971	81.1	5.1	8.6
7	Raneem F <sub>1</sub>	80.0	5.5	7.7
8	MDS- INX-732	67.8	6.7	7.4
9	Hady F <sub>1</sub>	77.8	5.8	7.2
10	MDS-13 CU 5757	75.6	5.1	7.0
11	MDS-12 CU-5513	60.0	6.5	6.6
<b>LSD (0.05)</b>		<b>15.8</b>	<b>2.3</b>	<b>4.5</b>

The data in the above table revealed that germination %age ranges from 60% (MDS-12 CU-5513) to 82.2% (Hoosier F<sub>1</sub>). Germination percentage was more than 70% in all varieties except MDS-12 CU-5513 and MDS- INX-732. Number of fruit per plant is an important component of yield and has significant impact on production. Number of fruits per plant recorded on an average basis. Maximum numbers of fruits recorded on an average basis were 8.7 (Badshah) followed by 7.6 (Messi F<sub>1</sub>) whereas minimum numbers of fruits per plant were recorded 4.6 in variety Local. The check variety Local produced highest yield (17.1 t/ha) followed by Badshah (16.5 t/ha) and Messi F<sub>1</sub> (15.3 t/ha) whereas variety MDS-12 CU-5513 produced the lowest fruit yield of 6.6 t/ha. The low yield of variety MDS-12 CU-5513 may be due to low germination and early drying of plants. Those varieties that start fruits early are more acceptable in farming community.

Early fruits fetch higher prices in the market in early days of fruit season and so that's why there can be the maximum profit by growing early fruiting varieties. Badshah and Messi F<sub>1</sub> started fruiting from 3<sup>rd</sup> week of April.

**Table-82 Performance of Cucumber hybrids/varieties in an adaptability trial at Vegetable Research Institute, Faisalabad during Kharif 2016 (Set-II)**

S. No.	Varieties	Germination %	No. of fruits / plant	Fruit yield (t/ha)
1	Advanta F <sub>1</sub> 702	87.8	7.5	20.0
2	Advanta F <sub>1</sub> 701	87.8	7.1	18.5
3	<b>Local (Check)</b>	<b>78.9</b>	<b>4.9</b>	<b>18.0</b>
4	Saram F <sub>1</sub>	87.8	7.5	17.8
5	Asian-I	82.2	7.0	14.6
6	Dinar F <sub>1</sub>	92.2	6.2	14.0
7	Liza	93.3	6.8	13.5
8	CU-4562	86.7	6.7	13.2
9	Alpha Prime	85.6	6.9	12.9
10	Safaa	78.9	7.1	11.3
11	Thamin II	83.3	5.8	10.4
12	Jarrar F <sub>1</sub>	83.3	5.9	8.5
	<b>LSD (0.05)</b>	<b>12.4</b>	<b>2.1</b>	<b>5.5</b>

The data in the above table revealed that germination % age ranges from 78.9% (Safaa) to 93.3% (Liza). Germination percentage was more than 78 % in all the varieties. Number of fruits per plant was recorded on an average basis. Maximum number of fruits recorded on an average basis were 7.5 (Advanta F<sub>1</sub>702 and Saram F<sub>1</sub>) followed by 7.1 (Advanta F<sub>1</sub>701) whereas minimum numbers of fruits per plant (4.9) were recorded from variety Local but the average fruit weight is more than any variety. The exotic variety Advanta F<sub>1</sub>702 produced highest yield (20 t/ha) followed by Advanta F<sub>1</sub>701 (18.5 t/ha), Local (18 t/ha) and Saram F<sub>1</sub> (17.8 t/ha). All these varieties are statistically non-significant. The hybrid Jarrar F<sub>1</sub> produced the lowest fruit yield of 8.5 t/ha. Those varieties that start fruits early fetch higher prices in the market in early days of fruit



season. Local variety has ability to tolerate more heat as compared to others that is why the crop condition at this stage is better than other varieties.

**Table-83 Performance of Cucumber hybrids/varieties in an adaptability trial at Vegetable Research Institute, Faisalabad during Kharif 2016 (Set-III)**

S. No.	Varieties	Germination %	No. of fruits / plant	Fruit yield (t/ha)
1	Local (Check)	77.8	5.0	15.4
2	Karizma	74.4	3.9	11.6
3	Dania 730 F <sub>1</sub>	84.4	4.4	8.3
4	Vella F <sub>1</sub>	95.6	3.6	7.0
5	Spider F <sub>1</sub>	91.1	4.5	6.9
6	Zoro F <sub>1</sub>	86.7	4.7	6.9
7	Porto F <sub>1</sub>	90.0	3.9	6.5
8	Tiger 990 F <sub>1</sub>	88.9	3.7	6.3
9	Vareene F <sub>1</sub>	87.8	3.6	6.3
10	Chaman F <sub>1</sub>	85.6	3.1	4.2
11	Falcon F <sub>1</sub>	86.7	2.7	3.9
12	Indus F <sub>1</sub>	86.7	2.7	3.5
<b>LSD (0.05)</b>		<b>13.3</b>	<b>0.9</b>	<b>3.4</b>

The data in the above table revealed that germination %age ranges from 74.4% (Karizma) to 95.6% (Vella-F<sub>1</sub>). Germination percentage was more than 74% in all varieties. Number of fruits per plant recorded on an average basis. Maximum numbers of fruits recorded on an average basis were 5 (Local) followed by 4.7 (Zoro F<sub>1</sub>) and 4.5 (Spider F<sub>1</sub>) whereas minimum numbers of fruits per plant recorded were 2.7 of varieties Falcon F<sub>1</sub> and Indus F<sub>1</sub>. The local variety produced highest yield (15.4 t/ha) followed by Karizma (11.6 t/ha) whereas variety Indus F<sub>1</sub> produced the lowest fruit yield of 3.5 t/ha. Those varieties that start fruits early fetch higher prices in the market in early days of fruit season. Local variety has ability to tolerate more heat as compared to others that is why the crop condition at this stage is better than other varieties.

**Table-84 Performance of Cucumber hybrids/varieties in an adaptability trial at Vegetable Research Institute, Faisalabad during Kharif 2016 (Set-IV)**

S. No.	Varieties	Germination %	No. of fruits / plant	Fruit yield (t/ha)
1	Target Karina	90.0	5.6	13.9
2	<b>Local (Check)</b>	<b>71.1</b>	<b>3.3</b>	<b>8.7</b>
3	227-G F <sub>1</sub>	92.2	3.5	6.4
4	Sunshine F <sub>1</sub>	74.4	4.3	5.9
5	Lina F <sub>1</sub>	94.4	3.2	5.2
6	Proton F <sub>1</sub>	78.9	3.0	4.5
7	Kalaam F <sub>1</sub>	80.0	2.7	3.3
8	Honey AB	66.7	3.6	3.3
<b>LSD (0.05)</b>		<b>10.4</b>	<b>1.5</b>	<b>3.7</b>

The varieties sown in this set were in the field where cauliflower crop was harvested. The overall low yield of the varieties in this set may be due to this effect. The data in the above table revealed that germination %age ranges from 66.7% (Honey AB) to 94.4% (Lina F<sub>1</sub>). Germination percentage was more than 70% in all varieties except Honey AB. Number of fruit per plant is an important component of yield and has significant impact on production. Number of fruits per plant recorded on an average basis. Maximum numbers of fruits recorded on an average basis were 5.6 (Target Karina) followed by 4.3 (Sunshine F<sub>1</sub>) whereas minimum numbers of fruits per plant recorded were 2.7 which is of variety Kalaam F<sub>1</sub>. The exotic variety Target Karina produced higher yield (13.9 t/ha) followed by Local (8.7 t/ha) and 227-G F<sub>1</sub> (6.4 t/ha) whereas variety Honey AB and Kalaam F<sub>1</sub> produced the lowest fruit yield of 3.3 t/ha. The low yield of variety Honey AB may be due to low germination. Those varieties that start fruits early fetch higher prices in the market in early days of fruit season.

## 17.2 DEVELOPMENT OF SOURCE POPULATION

The varieties/strains namely Badshah, Messi F<sub>1</sub>, Alpha Prime, Safaa, Liza, Saram F<sub>1</sub>, Advanta F<sub>1</sub> 701, Advanta F<sub>1</sub> 702, Asian-I and Local (Check) were sown on both sides of raised beds made at 2.5 m apart in open field on March 07, 2016 for the development of source population. Agronomic and plant protection measures were kept constant for all the varieties. At flowering stage, pollen of all the varieties was collected and bulked and

then the female flowers of all the above mentioned varieties were pollinated to obtain source population. At maturity, ripened fruits were picked and seed was extracted for further studies. Mostly the lines which were planted were hybrids and these produce only female flowers and the crosses made by using these female flowers were not become successful. Anyhow few fruits of Kheera local variety mated by different pollens were collected and seed of those crossed fruits were extracted for further studies.

## **18. BOTTLE GOURD (*Lagenaria siceraria*)**

### **18.1 COLLECTION AND MAINTENANCE OF LOCAL AND EXOTIC GERMPLASM OF BOTTLE GOURD**

The seed of an exotic variety and one local variety were sown on 25-02-2015 in Isolations in order to maintain the purity. Isolation was created by keeping the distance of one kilometer between the entries. The plot size was kept as 5 m × 7 m with plant to plant distance of 45 cm. The material was sown on both sides of raised beds. The recommended agronomic and plant protection measures were adopted to maintain the crop. True to type plants were selected and maintained through sibbing. The fruit was harvested at maturity and the seed was collected for further studies.

### **18.2 EVALUATION OF BOTTLE GOURD VARIETIES/HYBRIDS IN ADAPTABILITY TRIAL**

Twenty two exotic varieties/hybrids received from different seed companies were tested along with one check variety (local) for their performance evaluation in adaptability trial at Vegetable Research Institute, Faisalabad during Kharif 2016. Sowing was done on 25-02-2016 according to randomized complete block design with three replications. The plot size was kept as 5 × 7 m with plant to plant distance of 45 cm. The recommended agronomic and plant protection measures were adopted to maintain the crop. The data recorded for fruit yield is presented in table below

**Table-85 Performance of Bottle gourd Varieties/Hybrids in Adaptability Trial during 2015-16**

<b>S. No.</b>	<b>Genotype</b>	<b>Fruit Yield t/ha</b>
1	Green Gulo	8.55
2	Pride F <sub>1</sub>	8.53
3	4590 F <sub>1</sub>	7.95
4	<b>Faisalabad Round (Check)</b>	<b>7.77</b>
5	Diamond AB F <sub>1</sub>	7.39

6	Advanta F <sub>1</sub>	6.89
7	Advanta F <sub>1</sub>	6.81
8	Gulo F <sub>1</sub>	6.56
9	Hazarvi F <sub>1</sub>	6.14
10	4545 Lattu	6.11
11	Waleed F <sub>1</sub>	5.96
12	Gulshan F <sub>1</sub>	5.90
13	Tipu F <sub>1</sub>	5.89
14	Advanta F <sub>1</sub>	5.80
15	Kamal F <sub>1</sub>	5.44
16	Rasham F <sub>1</sub>	5.12
17	Raja F <sub>1</sub>	4.89
18	Hybrid Bottle gourd F <sub>1</sub>	4.81
19	Moomal AB, F <sub>1</sub>	4.45
20	Shaheen F <sub>1</sub>	4.34
21	Komal F <sub>1</sub>	4.06
22	Bot 403	4.05
23	Arya	3.43
<b>LSD (0.05)</b>		<b>2.22</b>

The above table shows that Hybrid Gourd Green Gulo and Pride F<sub>1</sub> are at the top in yield comparison while 4590 F<sub>1</sub> and diamond F<sub>1</sub> are almost equal to check Faisalabad Round. All other hybrids/Varieties are lower than check.

### **18.3 EVALUATION OF BRINJAL VARIETIES/HYBRIDS IN ADAPTABILITY TRIAL**

The seed of twenty brinjal entries including checks were sown on 27-01-2016 for raising the nursery and seedlings were transplanted in the field on 05-04-2016. The trial was laid out according to Randomized Complete Block Design with three replications in a plot size of 5.5 × 1.5m. The seedlings were transplanted with plant to plant distance of 50 cm. Standard cultural practices and plant protection measures were adopted. The fruit yield data is given in the table below.

**Table-86 Performance of Brinjal Entries during Kharif 2015-16**

S. No.	Genotypes	Yield (t/ha)
1	KHBR.205E	14.66
2	KHBR.202B	13.89
3	Rani	12.66
4	<b>Dilnasheen (Check Round)</b>	<b>11.42</b>
5	Cluster King	11.37
6	Advanta 326	10.70
7	<b>Nirala (Check Long)</b>	<b>10.24</b>
8	Janak	8.76
9	Bemisal	8.72
10	Advanta 301	8.35
11	KHBR.206F	8.01
12	Advanta 303	7.91
13	KHBR.201A	6.39
14	KHBR.204D	5.88
15	Sultan	5.27
16	GHB-1	5.19
17	WER(White Round)	5.10
18	Sundar	4.42
19	KHBR.203C	2.34
20	AB.377	1.78
<b>LSD (0.05)</b>		<b>3.95</b>

The data shown in the above table reveals that three hybrids are above round and five are above long check in fruit yield comparison. Almost all black and purple varieties/hybrids showed tolerance against fungal diseases while white eggplant is susceptible. All varieties/hybrids were equally attacked by fruit and shoot borer except white eggplant. White eggplant is less attractive to fruit and shoot borer.

## **19. CORIANDER (*Corriandrum sativum*)**

### **19.1 MAINTENANCE OF CORIANDER VARIETIES DURING RABI 2015-16**

Two coriander varieties named as Dilpazeer and Qandhari were sown on 03-11-2015 in Isolations in order to maintain the purity. Isolation was created by keeping the distance of one kilometer between the entries. The plot size was kept as 5 × 0.75 m. The

recommended agronomic and plant protection measures were adopted to maintain the crop. True to type plants were selected and maintained. The crop was harvested at maturity and the seed was collected for further studies.

## **20. SPINACH (*Spinacia oleracea*)**

### **20.1 MAINTENANCE OF SPINACH VARIETIES DURING RABI 2015-16**

Two spinach varieties named as Desi Palak and Lahori Palak were sown on 03-11-2015 in Isolations in order to maintain the purity. Isolation was created by keeping the distance of one kilometer between the entries. The plot size was kept as 5 × 0.75 m. The recommended agronomic and plant protection measures were adopted to maintain the crop. True to type plants were selected and maintained. The crop was harvested at maturity and the seed was collected for further studies.

## **21. GARLIC (*Allium sativum*)**

### **21.1 MAINTENANCE OF GARLIC GERMPLASM**

Two clones of garlic Gulabi and white were sown in the field on 08-10-2015 by keeping plant to plant and row to row distance of 10 cm and 20 cm, respectively in a plot size of 7 × 3 m. The crop was observed closely and diseased plants were rouged out to produce pure seed.

### **21.2 NUYT OF GARLIC GENOTYPES SOWN AT VEGETABLE RESEARCH INSTITUTE FAISALABAD DURING 2015-16**

Four Genotypes received from NARC Islamabad were tested along with one check variety Ghulabi (local) for their performance in trial at Vegetable Research Institute, Faisalabad. Sowing was done on 08-10-2015 in randomized complete block design with three replications. The plot size was kept as 4 × 1.5m with plant to plant distance of 10cm. The recommended agronomic and plant protection measures were adopted to maintain the crop. Variety G15127 and check were harvested on 18-04-2016 and remaining three entries were harvested on 09-05-2016 as these entries took almost one month extra period to mature. Yield data is given in table below: -

**Table-87 Performance of Garlic Genotypes in NUYT during 2015-16**

<b>S. No.</b>	<b>Genotype</b>	<b>Yield t/ha</b>
1	G15101	24.93
2	G15122	14.14

3	G15127	12.11
4	<b>Ghulabi (Check)</b>	<b>11.00</b>
5	G15109	10.58
<b>LSD (0.05)</b>		<b>3.30</b>

Above data shows that three entries are above check in yield comparison but first two varieties and the last one i.e. G15101, G15122 and G15109 took almost one month extra to mature. Genotype G15101 showed bolting behavior. In genotypes G15122 and G15109 there were no clove formation just leaves like onion bulb.

## **22. VEGETABLE MARROW (*Cucurbita pepo*)**

### **22.1 MAINTENANCE OF VEGETABLE MARROW LINES**

To maintain two biotypes of vegetable marrow, Pear Shape was maintained in isolation while Round Shape was maintained through sib-mating. Pear Shape was sown on 10.03.2016 by keeping plant to plant distance of 40 cm and row to row distance of 125 cm on an area of 4 kanal in Agronomy area, A.A.R.I., Faisalabad. Picking of matured true to type fruits was done during the 09.06.2016. Fruits were stored under shade and later on seed was extracted and stored after sun drying.

Round shape was sown on 07.03.2016 by keeping plant to plant distance of 40 cm and row to row distance of 125 cm. It was maintained through sib-mating. Picking of true to type matured fruits was done during 2<sup>nd</sup> week of May 2016. Fruits were stored under shade and later on seed was extracted and stored after sun drying.

### **22.2 DEVELOPMENT OF INBRED LINES**

Inbred line development programme have been initiated in vegetable marrow with an aim to develop hybrids. Sowing of crop material was done on 07.03.2016 by keeping plant to plant spacing of 40 cm and row to row spacing of 125 cm. For the purpose of selfing, male and female flowers were closed with jute string “Seba” one day before flower opening. Next day, just after the sunrise, jute string “Seba” was removed and male flowers were detached from the plant. After removing sepal & petals of the male flower, its androecium was gently touched on stigma of female flower of the same plant. Female flowers were again closed with jute string to avoid stray pollen contamination due to honeybee’s visit, and female flowers were tagged for the purpose of identification. At maturity, fruits were picked individually and seed was extracted.

**S<sub>0</sub> GENERATION**

S. No.	Variety/Hybrid	No. of Fruits
1	Money Pani F <sub>1</sub>	1
2	Green Star F <sub>1</sub>	1
3	Dollar	1
4	SQ- 35-52	1
5	Dallas F <sub>1</sub>	1
6	Sitara F <sub>1</sub>	1
7	Squash-Sultan F <sub>1</sub>	1
8	Hybrid Squash- Amber AB-F <sub>1</sub>	1

**S<sub>1</sub> GENERATION**

S. No.	Name of Genotype	No. of Fruits
1	Sultan	1
2	Cash Ball	1
3	Round Ball	1

**S<sub>6</sub> GENERATION**

S. No.	Name of Genotype	No. of Fruits	S. No.	Name of Genotype	No. of Fruits
1	P-4-9-1-3-2-2-3-D	1	15	P-4-9-2-6-3-10-D	1
2	P-4-9-2-2-3-2-3-D	1	16	P-4-9-2-6-3-6-D	1
3	P-4-9-2-2-3-2-4-D	1	17	P-4-9-2-6-3-8-D	1
4	P-4-9-2-2-3-4-D	1	18	P-4-9-2-6-4-3-1-D	1
5	P-4-9-2-2-5-2-1-D	1	19	P-4-9-2-6-4-9-2	1
6	P-4-9-2-6-4-7-D	1	20	P-4-9-2-6-4-3-2-D	1
7	P-4-9-2-6-3-11-5-D	1	21	P-4-9-2-2-2-6-D	1
8	P-4-9-2-6-4-9-1	1	22	P-4-9-2-2-5-8-D	1
9	P-4-9-2-6-3-11-4-D	1	23	P-4-9-2-2-5-10-D	1
10	P-4-9-2-2-3-6-D	1	24	P-4-9-2-2-1-7-D	1
11	P-4-9-2-6-3-4-1-D	1	25	P-4-9-2-2-1-8	1
12	P-4-9-2-6-1-2-D	1	26	P-4-9-3-1-2-3-D	1
13	P4-9-2-3-1-5-D	1	27	P-4-9-2-3-1-8-D	1
14	RP-26-4-5-1-1-1-D	1	28	P-4-9-3-1-2-5-D	1
29	P-11-9-2-3-2-3-D	1	30	P-4-9-2-6-1-2-D	1
31	P-4-9-2-2-1-7-D	1	32	P-4-9-2-2-3-6-D	1
33	P-4-9-2-2-3-2-4-D	1	34	P-4-9-2-6-3-11-4-D	1
35	RP-2-3-2-7-2-3	1			

**22.3 PARENT MAINTENANCE AND HYBRIDS EVALUATION IN VEGETABLE MARROW**



Out Of Twenty two hybrid combinations only sixteen combinations could be maintained due to unexpected heavy rainfall that affected the germination of the remaining six cross hybrids. Sowing of material was done on 07.03.2016 by keeping plant to plant spacing of 40 cm and row to row spacing of 125 cm. the parents were maintained through selfing while crosses were evaluated on the yield basis and promising cross combinations were selected and selfing was also done in order to raise F2 generation for further hybridization programme. The detailed of fourteen parent genotypes use in crosses and twenty two cross combinations are given below;

S. No.	Crossing No.	Parent Genotype	No. of Fruits	S. No.	Crossing No.	Parent Genotype	No. of Fruits
1	1502	RP-26-2-2-9-3-D	1	8	1516	Pear-4-9-2-2-5-7-D	1
2	1503	RP-26-2-7-4-D	1	9	1518	Pear-4-9-2-6-2-5-D	1
3	1506	Pear-4-9-1-3-8-1-D	1	10	1519	Pear-4-9-2-6-3-7	1
4	1509	Pear-4-9-1-3-1-8-2-D	1	11	1521	Pear-4-9-2-6-3-11-D	1
5	1510	Pear-4-9-1-3-1-9-D	1	12	1522	Pear-4-9-2-6-4-3-D	1
6	1511	Pear-4-9-2-2-5-7	1	13	1527	Pear-7-1-2-5-D	1
7	1512	Pear-4-9-2-2-3-5-D	1	14	1528	Pear-10-3-8-1-2-1-D	1

**Table-88 Hybrid Cross combinations in Vegetable Marrow**

S. No.	Crosses	No. Fruits	Crosses	No. Fruits	Crosses	No. Fruits
1	1503 × 1502	1	1509 × 1510	1	1519 × 1509	1
2	1503 × 1506	1	1509 × 1516	1	1521 × 1503	1
3	1503 × 1521	1	1509 × 1528	1	1521 × 1528	1
4	1503 × 1528	1	1510 × 1527	1	1527 × 1503	1
5	1506 × 1502	1	1510 × 1528	1	1527 × 1506	1
6	1506 × 1511	1	1511 × 1527	1	1528 × 1510	1
7	1506 × 1519	1	1511 × 1528	1		
8	1506 × 1527	1	1516 × 1522	1		

#### **22.4 EVALUATION OF EXOTIC VARIETIES/ HYBRIDS IN ADAPTABILITY TRIAL**

Fifty four exotic varieties/hybrids received from different seed companies were tested along with one local check for their performance evaluation in adaptability trial at Vegetable Research Institute, Faisalabad during Kharif 2016. Sowing was done on

07.03.2016 according to Randomized Complete Block Design with three replications. The plot size was kept as 7.0 × 1.25 m with plant to plant distance of 40 cm. The recommended agronomic and plant protection measures were adopted to maintain the crop. The data recorded for fruit yield is presented below.

**Table-89 Performance of Exotic Vegetable Marrow at Vegetable Research Institute, Faisalabad during 2015-16 (Set-I)**

Rank	Genotypes	Fruit Yield (t/ha)
1	Money Pani F <sub>1</sub>	25.56
2	Green Star F <sub>1</sub>	24.21
3	TSQ-221	23.4
4	Olper F <sub>1</sub>	22.86
5	Oskar F <sub>1</sub>	21.27
6	Safa F <sub>1</sub>	20.91
7	King Ball F <sub>1</sub>	20.67
8	Polka F <sub>1</sub>	19.71
9	TSQ-223	17.91
10	Marina F <sub>1</sub>	15.45
11	Emeraland F <sub>1</sub>	14.79
12	Squash- Kamla F <sub>1</sub>	14.40
13	Oval Star F <sub>1</sub>	14.28
14	Asma F <sub>1</sub>	13.71
15	Frozen F <sub>1</sub>	12.51
<b>16</b>	<b>Pear shape (Check)</b>	<b>7.53</b>
	<b>LSD (0.05)</b>	<b>0.86</b>

The results from the above table showed that all exotic varieties/hybrids produced significantly higher fruit yields than local check entry Pear shape (7.53 t/ha). The highest fruit yield was recorded in exotic entry Money Pani (25.56 t/ha).

#### Set-II

**Table-90 Performance of Exotic Vegetable Marrow at Vegetable Research Institute, Faisalabad during 2015-16 (Set-II)**

Rank	Genotypes	Fruit Yield (t/ha)
1	Dollar	35.70
2	SQ- 35-52	30.84
3	Dallas F <sub>1</sub>	30.15
4	Euro F <sub>1</sub>	29.10
5	Scarla	26.55
6	Avila F <sub>1</sub>	25.83

7	Clarita	22.62
8	PS- 719	22.14
9	RSQ- 6700	20.55
10	Commander	19.41
11	Founder Ball	18.60
12	Anita	17.40
13	SQ- 35-53	15.96
<b>14</b>	<b>Pear shape (Check)</b>	<b>7.50</b>
<b>LSD (0.05)</b>		<b>0.99</b>

The above table reveals that all exotic varieties/hybrids produced significantly higher fruit yields than local check entry Pear shape (7.50 t/ha). The entry namely Dollar exhibited the highest fruit yield of 35.70 t/ha among all tested genotypes.

### Set-III

**Table-91 Performance of Exotic Vegetable Marrow at Vegetable Research Institute, Faisalabad during 2015-16 (Set-III)**

<b>Rank</b>	<b>Genotypes</b>	<b>Fruit Yield (t/ha)</b>
1	Squash-ICI-1701-F <sub>1</sub>	17.19
2	Squash. Vari. Nizza	16.68
3	Summer Squash- SQ-No.1	14.79
4	Squash-ICI-1702-F <sub>1</sub>	14.76
5	K-HSQ-1	14.67
6	Squash. Vari. Winters	13.68
7	Squash. Vari. Heat Master	13.23
8	Squash-ICI-1703-F <sub>1</sub>	11.52
9	Squash-ICI-1704-F <sub>1</sub>	11.46
10	Squash-HSQ- 2	11.46
11	Squash-ICI-1705-F <sub>1</sub>	10.56
12	Squash-ICI-1706-F <sub>1</sub>	9.78
<b>13</b>	<b>Pear shape (Check)</b>	<b>7.50</b>
14	Beauty222(Chapani Tindi)	5.49
15	Malika F <sub>1</sub>	4.05
<b>LSD (0.05)</b>		<b>0.31</b>

The table reveals that the entries ranked from 1-12 depicted significantly higher fruit yields than local check entry Pear shape (7.50 t/ha). However, the highest fruit yield was recorded in exotic entry Squash-ICI-1701-F<sub>1</sub> (17.19 t/ha) and lowest fruit yield of 4.05 t/ha was exhibited by the entry Malika F<sub>1</sub>.

### Set-IV

**Table-92 Performance of Exotic Vegetable Marrow at Vegetable Research Institute, Faisalabad during 2015-16 (Set-IV)**

Rank	Genotypes	Fruit Yield (t/ha)
1	Sitara F <sub>1</sub>	20.19
2	Squash- Sultan F <sub>1</sub>	19.86
3	Hybrid Squash- Amber AB-F <sub>1</sub>	18.30
4	Squash.Green Ball F <sub>1</sub>	17.49
5	Squash Sarah	16.68
6	Cavili-F <sub>1</sub>	15.54
7	Squash- E-260	9.84
8	Squash Ilham F <sub>1</sub>	8.97
9	Asian Ball F <sub>1</sub>	8.94
10	Mishal-F <sub>1</sub>	8.55
<b>11</b>	<b>Pear shape (Check)</b>	<b>7.62</b>
12	New Eskandrany H <sub>1</sub>	1.95
13	Santa F <sub>1</sub>	0.90
	<b>LSD (0.05)</b>	<b>0.38</b>

The table reveals that the entries ranked 1-9 depicted significantly higher fruit yields than local check entry Pear shape (7.62 t/ha). The entry named as Mishal-F<sub>1</sub> produced statistically at par fruit yield of 8.55 t/ha. The highest fruit yield was recorded in exotic entry Sitara F<sub>1</sub> (20.19 t/ha) whereas the lowest fruit yield was given by the entry Santa F<sub>1</sub> (0.30 t/ha).

## **23. TINDA GOURD (*Citrullus vulgaris* var. *fistulosus*)**

### **23.1 MAINTENANCE OF TINDA GOURD VARIETY**

The tinda gourd variety namely “Dilpasand” was maintained in isolation. For this purpose, the crop was sown on 13.04.2016 by keeping plant to plant distance of 40 cm and row to row distance of 250 cm on an area of 1 acre. Picking of matured true to type fruits was done during 01.07.2016. Fruits were stored under shade and later on seed was extracted and stored after sun drying.

### **23.2 EVALUATION OF TINDA GOURD ACCESSION FOR FURTHER HYBRIDIZATION PROGRAMME**

In order to develop source population in tinda gourd twenty new accessions had been sown on 08.04.2016 by keeping plant to plant spacing of 40 cm and bed width of 2.50 m (planted on both sides). These accessions had been open pollinated for accumulation of superior genes and on maturity the superior plants had been selected for further hybridization programmes.

### **23.3 DEVELOPMENT OF INBRED LINES**

Inbred line development programme is in progress in tinda gourd with an aim to develop hybrids. Sowing of crop material was done on 08.04.2016 by keeping plant to plant spacing of 40 cm and bed width of 2.50 m (planted on both sides). For the purpose of selfing, male and female flowers were covered with butter paper bags one day before flower opening. Next day, just after the sunrise butter paper bags were removed and male flowers were detached from the plant and its androecium was gently touched on the stigma of female flower of the same plant. Selfed female flowers were again covered with butter paper bags to avoid stray pollen contamination through insects and female flowers were tagged for identification. At maturity fruits were picked individually during 29.06.2016 and seed was extracted. The detail of selfed material is given below.

#### 23.4 S<sub>8</sub> GENERATION

Twenty six entries in S<sub>8</sub> generation were sown for the purpose of selfing. Sowing of crop material was done on 08.04.2016. Therefore, selfing was accomplished and seed was extracted individually. The detail of twenty six genotypes selfed is given below;

**Table-93 Detail of Selfed Fruits Harvested in S<sub>8</sub> Generation**

S. No.	Name of Genotype	No. of Fruits	S. No.	Name of Genotype	No. of Fruits
1	P-35--1-1-9-7-2	1	14	P-24-1-1-7-6-4	1
2	P-35-1-2-8-7	1	15	P-24-1-1-2-5	1
3	P-24-1-1-1-4	1	16	P-24-1-1-2-3	1
4	P-35-1-3-11-8-6	1	17	P-35-1-3-1-2-5-7	1
5	P-34-1-1-1-5-7	1	18	P-24-1-1-7-6-7	1
6	P-35-1-1-9-7-1	1	19	P-35-1-3-1-2-5-2	1
7	P-35-1-3-1-2	1	20	P-24-1-1-4-5	1
8	P-24-1-1-2—2	1	21	P-35-1-3-1-8-10	1
9	P-35-1-2-6-9	1	22	P-24-1-1-2-6	1
10	P-35-1-1-9-7-2	1	23	P-35-1-1-9-8	1
11	P-24-1-1-7-6-5-2	1	24	P-24-1-2-3-8	1
12	DP-4-2-2-7	1	25	P-35-1-3-1-2-6-2	1
13	P-35-1-3-1-2-5-1	1	26	P-35-1-1-9-8	1

#### 23.5 EVALUATION OF EXOTIC VARIETIES/ HYBRIDS IN ADAPTABILITY TRIAL

Three exotic varieties/hybrids received from different seed companies were tested along with one local check for their performance in adaptability trial at Vegetable Research Institute, Faisalabad during Kharif 2016. Sowing was done on 08.04.2016

according to Randomized Complete Block Design with four replications. The plot size was kept as 5.0 × 2.25 m with plant to plant distance of 40 cm. The recommended agronomic and plant protection measures were adopted to maintain the crop. The data recorded for fruit yield is presented below.

**Table-94**

Rank	Entry	Fruit Yield (t/ha)
1	Sanwal	7.49
2	<b>Dilpasand (Check)</b>	<b>6.41</b>
3	Variety 808	4.90
4	B. Tinda	4.39
<b>LSD (0.05)</b>		<b>0.72</b>

The results from the above table revealed that entry ranked at No. 1 namely Sanwal (7.49 t/ha) produced significantly higher fruit yield than local check Dilpasand (6.41 t/ha). The lowest yield of 4.39 t/ha was depicted by the entry B. Tinda.

#### 24. **TURMERIC (*Curcuma longa*)**

The crop was planted on April 03, 2015 in agronomy filed on an area of 4 kanal with plant to plant spacing of 20 cm and 60 cm of row to row spacing. All agronomic practices were adopted during the crop season at both locations and digging was started at maturity on February 09, 2016 and completed at February 12, 2016. The crop yield was obtained from Agronomy area as under;

**Table-95**

S. No	Tuber types	Yield (Kg)
1	Main Tubers	4882
2	Mother Tubers	1288
<b>TOTAL</b>		<b>6170</b>

#### 25. **FENUGREEK (*Trigonella foenum-graecum*)**

The seven diverge lines of the said crop were planted on October 01, 2015 on ridges on an area of 1 Kanal with R × R of 2.50 feet. After getting vegetative cuttings crop was left for seed production and at maturity the seed of seven fenugreek pure lines was obtained on 20.04.2016.

#### 26. **LETTUCE (*Lactuca sativa*)**

The nursery of the green and red leaved type genotypes of the said crop was planted on October 28, 2015 and transplanted on November 19, 2015 on an area of 14 merla. The yield data regarding cutting of the trial was done on January 01, 2016. The

seed harvesting was commenced on May 09, 2016 and accomplished on May 16, 2016 and seed was stored.

## 27. SEED PRODUCTION

Different varieties of winter and summer vegetables were planted at VRI, Faisalabad and its sub-stations on optimum sowing dates in isolation places. The off-type and diseased plants were rouged out in all the varieties during crop growth stages. The following quantity of Basic seed of different vegetables was produced during the year 2014-15 for distribution among the public and private seed companies and progressive vegetable growers.

**Table-96 Seed Production during 2015-16**

S. No.	Vegetable	Basic Seed (kg)
1	Cauliflower FD-I	1.500
2	Cauliflower FD-II	40
3	Cauliflower FD-III	10
4	Cauliflower FD-IV	1.300
5	Spinach	1607
6	Radish (40days)	895
7	Radish (Mino)	227
8	Radish (Lal pari)	96
9	Turnip (Golden)	475
10	Turnip (Purple Top)	428
11	Carrot	230
12	Peas	384
13	Onion	366
14	Muskmelon	58
15	Watermelon	3
16	Tinda	107.900
17	Long Melon	28
18	Brinjal	1.500

19	Bitter gourd (kareli)	11
20	Bitter gourd (karela)	40
21	Vegetable Marrow	60
22	Tomato F <sub>1</sub> Hybrid	2.506
23	Tomato (OPV)	6.200
24	Cucumber	2.500
25	Okra	1252
26	Bottle Gourd	225
27	Bitter Gourd	91.500
	<b>Total</b>	<b>6649.906</b>

## 28. SEED KITS

2,20,000 seed kits of winter (150,000) and summer (70,000) vegetables were prepared and distributed among the Kitchen Gardeners to promote kitchen gardening.

## 29. RESEARCH PROJECTS

- i. An ADP project “**Up-scaling of Kitchen Gardening in Urban areas of Punjab**” under the Chief Minister program regarding promotion of Kitchen Gardening is under execution.
- ii. A PARB funded project on tomato entitled as “**Development of tomato hybrids suitable for sowing in Tunnels and Open fields of Punjab**” is under execution.

## 30. PUBLICATIONS

Scientific	
Radio Talks	
TV Talks	
Urdu Articles	



