

1. PEAS (*Pisum sativum* L.)

1.1 REPORT ON ADAPTABILITY TRIAL OF EXOTIC PEA VARIETIES CONDUCTED AT VEGETABLE RESEARCH INSTITUTE, FAISALABAD DURING RABI 2019-20

Five 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 23-10-2019. The planting geometry of the trial is as under:

Method of Sowing	Dibble sowing on both sides of the beds
Plot Size	5 × 1.0 m
Plant to plant spacing	5 cm
Bed width	100 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-1 Performance of exotic pea lines at Vegetable Research Institute, Faisalabad during 2019-20

Rank	Varieties/ Line	Days to 50% flowering	100 seed weight Fresh (g)	green pod yield (T/ha)
1	Supreme (Check)	30.67	50.53	11.63
2	Alina super	30.33	51.33	9.36
3	Polo	75.00	61.33	9.26
4	EP-195 A	75.00	48.33	9.23
5	Pea-2009 (Check)	33.67	57.07	8.13
6	EP-190 B	34.00	46.67	7.03
7	Challenge	34.00	54.80	6.11
LSD (0.05)		0.93	2.91	1.93

The data presented in the above table reveals that locally checked variety Supreme (11.63 T/ha) produced better yield among all exotic varieties. The statistical analysis predicts that the exotic lines Alina super (9.36 T/ha), Polo (9.26 T/ha) and Ep-195A (9.23 T/ha) produced yield which are statistically lower with the better check variety. Variety Challenge produced the lowest yield (6.11 t/ha) among all lines. The lines EP-195A and Polo produced days to 50% flowering in 75 days and found late among all tested varieties whereas the check

variety Supreme produced days to 50% flowering in 30.67 days. Crop was observed disease free during the whole season.

2. CARROT (*Daucus carota* L.)

2.1 MAINTENANCE OF CARROT GERMPLASM

Seed of six genotypes viz; 4 red genotypes (DC-3, DC-4, DC-90, and T-29), one purple genotype (DC-B), and one orange genotype (Orange-07) was sown on 15-10-2019 for their maintenance. All the recommended agronomic and plant protection measures were adapted. Superior carrot roots of each genotype were selected during the month of February, 2020, made their stecks and sown in an isolation. The genotype DC-4 was kept in field till the end of March to select frost tolerant, non-bolter genotype to meet market demand and acceptability for late season. The “Black Carrot” (DC-B) was selected for purity and uniformity of purple pigments throughout the xylem and phloem. The brix of DC-B was recorded to be 6 with Hand Refractometer. Small quantity of seed of each genotype is available for future manipulation.

2.2 DEVELOPMENT OF CARROT VARIETIES FOR EARLY SOWING:

Two genotypes viz; DC-3 and DC-90, and two populations viz; Pop.1-17 and Pop.2-17 were sown on 15-10-2019. The sowing was done on both sides of 75 cm wide ridges. Selection was done on the basis of root color and marketable roots. The transplanting of selected roots was done after 90 days for DC-90 and Pop.1-17 whereas DC-3 and Pop.2-17 were selected after 120 days of sowing to develop the lines for normal crop span of the crop. The brix of Pop.2-17 was recorded to be 10 whereas this value was recorded to be 8 for Pop.1-17. The skin root color of Pop.1-17 is red but its core color is white. Root hairs are also present on its skin. The line DC-90 is early line with red root skin color but its root core color is white. Root hairs were recorded to be present on its skin. The root skin color of Pop.2-17 is red, its root core is thin and white in color. The brix of Pop.2-17 was recorded to be 10 with Hand Refractometer. It has attained much improvement almost in every respect. DC-3 has attained sufficient improvement in root skin and root core color (both are red). Its brix was recorded to be 8 with Hand Refractometer and may be approved in near future. All four lines have good taste.

2.3 DEVELOPMENT OF CARROT VARIETY SUITABLE FOR LATE PLANTING

Seed of two genotypes viz; DC-4 and Orange-07 were sown on 15.10.2019. DC-4 is a red line, bolting is late. Its bolting starts at the 3rd week of March and hence it can be marked till the end of March without quality deterioration. The Orange-07 (DC-Orange) was derived from non-bolters exotic orange hybrid populations through chilling. The sowing of the

material was done on both sides of 75 cm wide ridges. Plant to plant distance was kept as 3 cm by thinning after three weeks of germination. Selection was based on tolerance to frost, marketable root and non-bolting behavior till the end of March in order to develop a frost tolerant, late bolting variety for long time availability in the market. Orange-07 is the line having orange skin and core color. Its brix was recorded to be 8 with Hand Refractometer. It requires further improvement in skin color.

2.4 DEVELOPMENT OF CARROT CMS LINES

Seed of 98 entries (both female and male lines) comprising of BC-6(Female Lines=49) and F-7 (Male Lines=49) was sown on 14.10.2019 to develop CMS Lines (both Maintainer and Restorer). Carrot roots of each entry were harvested in the 1st week of February, 2020. Stecks of ten superior carrot roots of selected entries (45 entries) were made and treated with fungicide and sown for further study. Fifty fresh crosses were made in the first week of April, 2020 and successfully harvested in the month of June, 2020. The successful crosses (50 crosses) will be used for further back crossing and selfing to develop three line breeding systems for hybrid development.

2.5 ADAPTABILITY TRIAL OF CARROT VARIETIES/HYBRIDS CONDUCTED AT VEGETABLE RESEARCH INSTITUTE FAISALABAD DURING 2019-20

Ten carrot varieties/ hybrids received from different seed companies were tested for their performance in adaptability trial in two sets at Vegetable Research Institute, Faisalabad during Rabi 2019-2020

SET-I

Trial was conducted in randomized complete block design with three replications. The plot size was kept as 6 m x 1.5 m. Trial was sown on 15.10.2019. The recommended agronomic and plant protection measures were adopted to maintain the crop. Harvesting was done on 11.02.2020. The data recorded is presented below.

Table-2 Performance of Exotic Carrot Lines at Vegetable Research Institute, Faisalabad during 2019-20

Rank	Entry	Yield (T/Ha)	Root Length (cm)	Root Width (mm)	Root Skin Color
1	DC-3	43.9	23.7	28.9	Red
2	T-29	43.2	25.7	28.5	Red
3	Rudhira	42.1	25.2	27.6	Red
4	AS-725	39.1	25.6	28.3	Red
5	HCR-341A	36.9	17.3	28.6	Orange

6	HCR-340B	36.9	15.8	28.2	Orange
7	Red Rose	36.6	25.5	26.1	Red
8	Gulabo	36.2	24.6	29.2	Red
9	Rosy F ₁	18.3	25.9	27.1	Red
	LSD ($\alpha= 0.05$)	4.5			

Genotype DC-3 exhibited the highest root yield (43.9 T/Ha). Varieties at rank 3 and 4 are statistically at par to check cultivar T-29.

Set II

Trial was conducted in randomized complete block design with three replications. The plot size was kept as 4 m x 1.5 m. Trial was sown on 28.10.2019. The recommended agronomic and plant protection measures were adopted to maintain the crop. Harvesting was done on 25.03.2020. The data recorded is presented below.

Table-3 Performance of Exotic Carrot Lines at Vegetable Research Institute, Faisalabad during 2019-20

Rank	Entry	Yield (t/ha)	Root Length (cm)	Root Width (mm)	Root Skin Color
1	Orange-07	34.3	19.6	21.0	Orange
2	T-29	31.8	18.6	21.8	Red
3	DC-3	29.7	19.2	21.9	Red
4	Diamond 202	23.8	19.1	20.8	Red
5	Red Lady	23.8	22.4	22.2	Red
6	Diamond 201	16.3	19.4	21.4	Red
	LSD (0.05)	9.3			

Genotype Orange-07 exhibited the highest root yield (34.3 t/ha). Varieties at rank 3 to 5 are statistically at par to check cultivar T-29.

2.6 NATIONAL UNIFORM YIELD TRIAL (NUYT) OF CARROT CULTIVARS CONDUCTED AT VEGETABLE RESEARCH INSTITUTE, FAISALABAD DURING 2019-20

Seed of three coded entries of carrot namely CT-19013, CT-19017 and CT-19019 was received from PARC, Islamabad on 20.11.2019 for testing their performance at VRI, Faisalabad. These coded entries along with four genotypes of VRI, Faisalabad namely DC-3, DC-4, Orange-07 and one Check Variety T-29 were sown in the research area of VRI, Faisalabad. The trial was conducted in Randomized Complete Block Design with three replications. The plot size was kept as 1.52m x 4m. The trial was sown on 21.11.2019. The

recommended agronomic and plant protection measures were adopted uniform to nourish the crop. Harvesting of the trial was done on 13.03.2020. The data recorded is tabulated below.

Table-4 Performance of Exotic Carrot Lines at Vegetable Research Institute, Faisalabad during 2019-20

Rank	Entry	Root Yield (t/ha)	Plant Height (cm)	Root Length (cm)	Root Diameter (mm)	Root Skin Color	Root Hairs (P/A)
1	Orange-07	6.58	123.5	20.6	15.2	Orange	Present
2	T-29	6.14	120.3	19.7	17.21	Red	P
3	CT-19017	5.87	124.8	20.9	15.8	Red	P
4	DC-4	5.32	122.0	20.1	19.3	Red	P
5	DC-3	5.15	138.0	21.5	16.8	Red	P
6	CT-19019	5.04	129.0	17.9	17.0	Red	P
7	CT-19013	4.58	127.8	21.3	16.9	Yellow	P
	LSD(0.05)	1.14					

Cultivar Orange-07 exhibited the highest root yield (6.58 t/ha) followed by T-29 (6.14 t/ha) which is non-significant with cultivar CT-19017 (5.87 t/ha). The genotypes ranked from 4 to 7 are non-significant with each other so far as their root yield is concerned.

3. RADISH (*Raphanus sativus*)

3.1 ADAPTABILITY TRIAL OF RADISH VARIETIES

The Radish varieties/hybrids White Long, HRD-220D, HRD-223 E, HRD-222 B, HRD-225 B, HRD-224 C, No.45 and White Sturdy were tested in open field at Vegetable Research Institute, Faisalabad along with Mino Selection as a check. The lay out was according to RCBD with three replications. The sowing was done on 10-10-2019, with plot size 3.0 x 7.0 m (2 lines on the ridge) apart. All agronomic and plant protection measures were adopted to maintain the crop. The harvesting of the roots was started on 12-12-2019. The data recorded for root yield is presented in the table below.

Table-5 Performance of Radish Varieties in Adaptability Trial at VRI, Faisalabad during 2019-20

S. No.	Varieties	Yield (T/ha)
1	White Long	58.07
2	White Sturdy	53.31
3	HRD-220 D	47.6
4	HRD-225 B	47.6
5	Mino Selection	45.70
6	HRD-223 E	44.27
7	HRD-222 B	42.36
8	No.45	42.36

9	HRD-224 C	40.94
LSD (0.05)		2.17

The maximum root yield (58.07 t/ha.) gave by variety **White Long** followed by **White Sturdy**, with root yield of 53.31 t/ha. All varieties were found significant statistically.

3.2 PRE-BASIC SEED PRODUCTION IN RADISH

To maintain the purity, seed of five radish varieties viz., 40 Days, Mino selection, Mino Local, Red meet and Lal Pari was sown during the month of September, 2019. 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, 2019 for the production of pre-basic seed in isolation (1000 m). Early bolters and late bolters were rouged out from the seed production plots to maintain the variety. Detail of the seed produced is given below.

Table-6 Pre-basic seed produced during 2019-20

S. No.	Varieties	Quantity (g)
1	40 Days	266
2	Desi White	200
3	Lal Pari	129
4	Mino Selection	71

4. TURNIP (*Brassica comprestis* var. *rapa*)

4.1 ADAPTABILITY TRAIL OF EXOTIC TURNIP 2019-2020

The Turnip varieties/hybrids E.T.P-231 B, E.T.P-232 C, E.T.P-230 A, G.T-200 and P.T-100 were tested in open field at Vegetable Research Institute, Faisalabad along with Purple Top as a check. The lay out was according to RCBD with three replications. The sowing was done on 10-10-2019, with plot size 3.0 x 7.0 m (2 lines on the ridge) apart. All agronomic and plant protection measures were adopted to maintain the crop. The harvesting of the roots was started on 12-12-2019. The data recorded for root yield is presented in the table below.

Table-7 Performance of Turnip Varieties in Adaptability Trial at VRI, Faisalabad during 2019-20

Sr. No.	Varieties	Yield (T/ha)
1	ETP-231 B	42.48
2	Purple Top	35.36
3	ETP-232 C	33.00
4	ETP-230 A	31.81
5	GT-200	28.67
6	PT-100	27.92

LSD (0.05)	5.86
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The maximum root yield (42.48 t/ha.) gave by variety ETP-231 B followed by Purple Top, with root yield of 35.36 t/ha. All varieties were found significant statistically.

4.2 PRE-BASIC SEED PRODUCTION IN TURNIP VARIETIES

Single plant progenies of Purple top and golden varieties will be sown during 2nd week of September 2019 on both sides of ridges made 75 cm apart in row length of 7 meters. True to type steckling will be selected and planted in November 2019 in isolation. Off-type, early bolters, late bolters and diseased plants were rogued out at different stages of crop growth. True to type will be selected and bulked for the production of pre-basic seed. At crop maturity 80 single plants of Purple Top and 72 single plants of Golden Ball Faisalabad were harvested and collected as Pre-basic seed of 500 gm of variety Purple Top and 400 gm of golden ball.

4.3 EVALUATION OF HEAT TOLERANCE LINE OF TURNIP

The trial was sown on 08.08.2019 and harvesting was done 01.11.2019 for comparison of heat tolerance among different genotypes. Five traits: Number of leaves per plant, length of leaf per plant, width of root per plant, length of root per plant and ratio length to root was calculated by length divided by width. The data was calculated by averaging the five plants in each trait. According to table the lowest ratio got by purple Top Agitta (1.13), which means near to round shape, whereas maximum ratio was got by Purple Top (Exotic) 1.85, which means oblong shape. It is due to heat effect.

Table-8 Types of Purple Top Group, Showing Different Traits

Types of Turnip	No. of Leaves	Length of leaves (cm)	Width of root (cm)	Length of root (cm)	Length/Width
Purple Top (S)	10.8	36.0	3.8	6.4	1.68
Purple Top (Agita)	13.20	34.8	6.00	6.8	1.13
Purple Top (N)	8.6	30.9	4.8	6.2	1.29
Purple Top (Exotic)	9.7	32.8	4.1	7.6	1.85

5. Musk Melon (*cucumis melo* L.)

5.1 MAINTENANCE OF OPEN POLLINATED MUSKMELON VARIETIES

Four elite varieties i.e. No.3., No.12., Green Flesh & T-96(Small) were sown in plot size of 7 × 3 m on both sides of 3 meter wide beds with plant to plant spacing of 45 cm in isolation in March 2020. Diseased and undesirable plants were rogued out and remaining plants in each variety was allowed to random mate. At maturity desirable fruits were harvested and selection was made on the basis of quality traits. Seed of selected fruits was collected for further selection cycle. Characteristics of the selected fruits of four varieties are mentioned below in table.

Table-9 List of Muskmelon Genotypes

Line Name	Rind color	Fruit Shape	Stripes type	Flesh color	Flesh Texture	Weight Range (g)	Brix % (TSS)
NO.3	Yellow	oblate	No stripes	White	Soft	400-500	12-16
NO.12	Yellow	-do-	No stripes	White	Soft	700-800	11-13
Green Flesh	Green	-do-	No stripes	Light green	Medium hard	600-800	12-17
ST-96	Green with stripes	-do-	Stripes	Light orange	Medium hard	200-300	13-16

5.2 PRE-BASIC SEED PRODUCTION OF MUSKMELON

To maintain the purity, seed of two muskmelon varieties viz., T-96 and Ravi was sown in isolation during 2nd fortnight of February 2020 on both sides of 300 cm wide beds keeping plant-to-plant distance of 45 cm. All off-type and diseased plants were roughed before flowering and later stages of crop growth. At maturity harvested fruits and collected the seed of true to type fruits, keeping in view the brix value %. The harvested seed were stored after drying.

5.3 ADAPTABILITY TRAIL OF MUSKMELN VARIETIETIES IN OPEN FIELD, 2020

The Muskmelon varieties/hybrids Sweet Baby, Shirka, Super One, Target-J-123, Rich Round, AAMM-42, AAMM-43, AAMM-44, AAMM-45, TMM-1103, TMM-1104, TMM-1105, White Elephant, and Top Super Kashmiri were tested in open field at Vegetable Research Institute, Faisalabad along with Two check varieties i.e. Ravi and T-96. The sowing was done on 21-02-2020, with plot size 3 x 7 m apart. All agronomic and plant protection measures were adopted to maintain the crop. The harvesting of the fruit was started on 01-06-2020. The data recorded for fruit yield and TSS is presented in the table below.

Table-10 Performance of Muskmelon Varieties in Adaptability Trial at VRI, Faisalabad during 2020

Sr. No.	Varieties	Yield (T/ha.)	TSS (%)
1	Super One	17.20	13
2	TMM-1104	16.64	13
3	TMM-1105	15.22	12
4	AAMM-45	13.49	12
5	Sweet Baby	12.90	12
6	Top Super Kashmiri	12.56	13
7	Ravi	12.25	14
8	T-96	12.05	13
9	Rich Round	11.81	12

10	Shirka	11.11	11
11	AAMM-42	10.03	13
12	AAMM-43	9.96	13
13	AAMM-44	9.10	10
14	TMM-1103	8.54	12
15	White Elephant	7.70	11
16	Target-J-123	4.99	9
	LSD (0.05)	2.98	

The maximum fruit yield (17.20 t/ha.) with TSS value of 13 % gave by variety/hybrid Super one followed by TMM-1104, with fruit yield of 16.64 t/ha with TSS value of 13%. All varieties were found significant statistically.

FINDINGS:

The imported varieties were found heat susceptible than check variety. However, all other varieties/ hybrids showed earliness in fruit bearing than the check variety.

6. WATERMELON (*Citrullus lanatus* L.)

6.1 EVALUATION OF EXOTIC VARIETIES/HYBRIDS OF WATERMELON IN ADAPTABILITY TRIAL CONDUCTED AT VEGETABLE RESEARCH INSTITUTE, FAISALABAD UNDER LOW TUNNEL DURING 2018-2019

Twelve entries in set-1, seven in set-2 along with check variety Sugar baby were sown on 05.12.2018 to check their adaptability. Sowing was done 50 cm apart in hills, according to Randomized Complete Block Design with three replications keeping plot size of 4.0 × 3.0 m. Germination of all the hybrids/varieties was satisfactory. Agronomic practices and plant protection measures were adopted regularly. Data regarding fruit yield and TSS were recorded and presented in the following tables.

Table-11 Yield performance of various Varieties/Hybrids of Watermelon during 2018-2019 (Set-I)

Rank	Variety/Hybrid	Viral Attack	Fungal Attack	TSS%	Yield (T/ha)
1	WMT 4807	MR	MR	11.83	20.41
2	Global F ₁	MR	MR	11.50	17.80
3	SVWC-4183	MR	MS	11.00	17.44
4	WS 118	MS	MR	11.83	14.51
5	Red King F ₁	MR	MS	10.83	13.68
6	WM 101	MR	MR	10.33	13.56
7	Boss F ₁	MS	MS	12.00	13.06
8	Super Black	S	MS	10.83	12.44
9	Turi F ₁	S	S	10.50	12.40
10	Sugar Baby (Check)	MR	MR	10.50	11.87
11	Civic F ₁	MS	S	13.00	11.64
12	SV17703WC	S	MR	11.33	10.55

13	WM -2159	HS	MS	10.00	9.43
LSD (0.05)				1.05	1.45

MR=Moderately resistant, MS=Moderately susceptible, S=Susceptible, HS=Highly susceptible.

The data presented in Table-69 revealed that all the hybrids / varieties showed highly significant differences for fruit yield and TSS% age. The hybrid/variety WMT 4807 exhibited the highest fruit yield of 20.41 T/ha followed by hybrid Global F₁ (17.80 T/ha) whereas, the hybrid/variety WM 2159 showed the lowest fruit yield (9.43 T/ha) in set-I.

Table-12 Yield performance of various Varieties/Hybrids of Watermelon during 2018-19 (Set-2)

Rank	Variety/Hybrid	Viral Attack	Fungal Attack	TSS%	Yield (T/ha)
1	WMH 4715	R	MR	11.67	21.68
2	Commander F ₁	MR	MS	11.33	20.31
3	WMT 4809	MR	MR	11.00	17.68
4	WS 218	MR	MS	11.00	17.11
5	Prime F ₁	MS	MS	11.00	17.05
6	Launcher	S	S	10.33	14.26
7	Shahnshah F ₁	S	S	10.67	12.67
8	Sugar baby (Check)	MR	MR	11.33	12.10
LSD (0.05)				NS	2.41

R= Resistant MR=Moderately resistant MS=Moderately susceptible S= Susceptible

The data presented in above table reveals that all the hybrids / varieties showed highly significant differences for fruit yield and non-significant differences for TSS% age. The hybrid/variety WMH 4715 exhibited the highest fruit yield of 21.68 T/ha followed by hybrid Commander F₁ (20.31 T/ha) whereas, the hybrid Shahnshah F₁ exhibited the lowest fruit yield (12.67 T/ha) in set-2.

6.2 EVALUATION OF EXOTIC VARIETIES/HYBRIDS OF WATERMELON IN ADAPTABILITY TRIAL CONDUCTED AT VEGETABLE RESEARCH INSTITUTE, FAISALABAD DURING KHARIF SEASON 2019

Sixteen entries in set-1, sixteen in set-2 along with check variety Sugar baby were sown on 15.03.2019 to check their adaptability. Sowing was done 50 cm apart in hills, according to Randomized Complete Block Design with three replications keeping plot size of 4.0 × 3.0 m. Germination of all the hybrids/varieties was satisfactory. Agronomic practices and plant protection measures were adopted regularly. Data regarding fruit yield and TSS were recorded and presented in the following tables.

Table-13 Yield Performance of various Varieties/Hybrids of Watermelon during 2019 (Set-1)

Rank	Variety/Hybrid	Viral Attack	Fungal Attack	TSS%	Yield (T/ha)
1	Himba	MS	MR	11.34	16.89

2	TWM-1610	MR	MR	10.44	15.73
3	NSCWM3 F ₁	S	MR	10.54	15.61
4	13-013 F ₁	MS	MR	11.00	14.44
5	Don F ₁	S	MS	11.43	14.34
6	Summer 7 F ₁	MS	MR	10.00	14.00
7	NSCWM2 F ₁	MS	S	12.56	13.64
8	Ronald	S	MS	11.67	13.25
9	Bukhara F ₁	S	MS	10.09	10.34
10	Sugar Baby (Check)	MS	MR	12.45	8.99
11	Zulu	S	MR	10.87	8.95
12	AAWM-4	S	MR	11.00	8.34
13	Opal-F ₁	HS	HS	9.65	7.05
14	Charlie-F ₁	S	HS	8.00	6.77
15	NSCWM1 F ₁	MS	S	12.00	5.64
16	AAWM-5	HS	HS	11.34	5.60
17	Paras F ₁	HS	HS	10.77	5.34
LSD (0.05)					2.81

MR=Moderately resistant, MS=Moderately susceptible, S=Susceptible, HS=Highly susceptible

The data presented in above table revealed that all the hybrids/varieties showed highly significant differences for fruit yield. The hybrid/variety Himba exhibited the highest fruit yield of 16.89 T/ha followed by hybrid/variety TWM-1610 (15.73 T/ha) whereas, the hybrid Paras F₁ showed the lowest fruit yield (5.34 T/ha) in set-I.

Table-14 Yield Performance of Various Varieties/Hybrids of Watermelon during 2019 (Set-2)

Rank	Variety/Hybrid	Viral Attack	Fungal Attack	TSS%	Yield (T/ha)
1	HWM-262 B	MS	MR	11.02	15.79
2	SH-01	MR	MR	11.34	15.56
3	AAWM-3	S	MR	11.45	15.41
4	AAWM-1	MS	MS	12.50	15.12
5	Big Ball	S	MR	11.09	14.54
6	Black Pearl	MS	MR	8.90	14.02
7	SZ-01	MS	MS	10.45	13.32
8	TWM-1608	S	S	11.00	11.12
9	Sugar Baby (Check)	MS	MS	11.45	9.18
10	HWM-272 B	S	S	12.45	9.09
11	TWM-104	S	S	9.56	9.00
12	12-175 F ₁	S	S	11.00	7.77
13	Target BG No.1 F ₁	HS	HS	12.56	7.44
14	AAWM-2	HS	HS	11.00	7.14
15	Ranger F ₁	MS	S	10.03	5.67
16	AAWM-6	S	HS	9.77	5.08
17	TWM-102	HS	HS	8.56	3.34
LSD (0.05)					3.22

MR=Moderately resistant, MS=Moderately susceptible, S=Susceptible, HS=Highly susceptible.

The data presented in above table reveals that all the hybrids / varieties showed highly significant differences for fruit yield. The hybrid/variety HWM-262 B exhibited the highest fruit yield of 15.79 T/ha followed by hybrid/variety SH-01 (15.56 T/ha) whereas, the hybrid/variety TWM-102 exhibited the lowest fruit yield (3.34 T/ha) in set-2.

Note: This year yield is low due to late sowing because of frequent rains at the time of sowing and spread of viral diseases and fungal diseases at maturity.

7. CAULIFLOWER (*Brassica oleracea* Var. botrytis)

7.1 DEVELOPMENT OF OPEN POLLINATED VARIETIES FOR 1st EARLY SEASON

The seed obtained from different farmers was sown in the field on 31-05-2019. Nursery of the population was transplanted on 09-07-2019 keeping plant to plant and row to row distance of 45 and 75 cm, respectively. Morphologically similar and healthy plants with desirable heads on the basis of color, shape and compactness were selected from progeny rows to start next selection cycle. Curds of the selected plants were shifted in isolation to avoid any contamination. At maturity seed of selected plants were harvested in bulk for further studies.

7.2 DEVELOPMENT OF OPEN POLLINATED VARIETIES FOR 2nd EARLY SEASON

The seed obtained from the random mated population of FD-II population was sown in the field on 16-07-2019. Nursery of the population was transplanted on 29-08-2019 keeping plant to plant and row to row distance of 30 and 75 cm, respectively. Morphologically similar and healthy plants with desirable heads on the basis of color, shape and compactness were selected within and between the progeny rows to start next selection cycle. At maturity seed of individual plants were harvested in bulk for further studies.

7.3 DEVELOPMENT OF OPEN POLLINATED VARIETIES FOR MID SEASON

The seed obtained from the random mated population of FD-III was sown in the field on 2-09-2019. Nursery of the population was transplanted on 10-10-2019 keeping plant to plant and row to row distance of 30 and 75 cm, respectively. Morphologically similar and healthy plants with desirable heads on the basis of color, shape and compactness were selected to get high yielding genotypes to start next selection cycle. At maturity seed of selected plants were harvested in bulk for further studies.

7.4 DEVELOPMENT OF CMS and MAINTAINER LINES IN 2nd EARLY AND MID SEASON GROUP OF CAULIFLOWER

To develop inbred lines for hybrid seed production, nursery of the genotypes of both season was sown in respective sowing period. Seedlings of 30-35 days were transplanted in the field. At maturity plants with desirable heads on the basis of color, shape and compactness were selected. At flowering time bud pollination procedure was used to self-pollinate the

genotypes. Further, some cytoplasmic male sterile plants were also identified and crossed with fertile plants to start back crossing. Detailed information is presented in table

Table-15 Detailed information of inbred line development

Cytoplasmic male sterile lines		Maintainer lines	
2nd Early season			
Number of lines	Generation	Number of lines	Generation
Five	BC ₁	Five	S ₂
Mid-Season			
Seven	BC ₂	Seven	S ₃
Nine	BC ₁	Nine	S ₂
Twelve	F ₁ /BC ₀	Twelve	S ₁

7.5 NUYT TRIAL OF CAULIFLOWER GENOTYPES

Six genotypes (2 received from NARC Islamabad and 4 included by VRI, FSD) were tested for their performance in NUYT trial at Vegetable Research Institute, Faisalabad. All the varieties were sown for raising the nursery on 18.07.2019. Seedlings of all varieties/hybrid were transplanted in the field on 29.08.2019 in randomized complete block design with three replications. The planting geometry of the trial was kept according to given instructions. The recommended cultural and plant production measures were adopted to maintain the crop. Replicated and average data of the required parameters are presented below.

Note*= Maturity days were calculated from the date of transplanting of nursery

Table-16 Average Data of NUYT of cauliflower 2019-20

Variety	Curd color	Maturity days*	Curd weight (kg)	Yield (kg/plot)	Yield t/ha
CF-19002	White	110-130	1.43	11.87	31.66
CF-19005	White	60-80	0.80	7.95	21.20
HCF-151A	Creamy white	85-100	0.56	5.64	15.05
HCF-900A	Creamy white	85-100	0.69	6.85	18.27
HCF-911A	Creamy white	90-110	0.71	7.10	18.93
Sohani	Creamy white	80-90	0.91	9.15	24.39

Table-17 Replicated Data of NUYT of cauliflower 2019-20

Variety	Replication	Curd weight (kg)	Yield (kg/plot)	Yield t/ha
Sohani	1	0.82	8.2	21.97
HCF-151A	1	0.60	6.0	16.00
HCF-900A	1	0.84	8.4	22.27
CF-19002	1	1.51	12.1	32.21
HCF-911A	1	0.77	7.7	20.53
CF-19005	1	0.87	8.7	23.20
Sohani	2	0.89	8.9	23.73

HCF-151A	2	0.47	4.7	12.53
HCF-900A	2	0.64	6.4	17.07
CF-19002	2	1.36	10.9	29.10
HCF-911A	2	0.71	7.1	18.93
CF-19005	2	0.70	7.0	18.56
Sohani	3	1.03	10.3	27.47
HCF-151A	3	0.62	6.2	16.62
HCF-900A	3	0.58	5.8	15.47
CF-19002	3	1.40	12.6	33.66
HCF-911A	3	0.65	6.5	17.33
CF-19005	3	0.82	8.2	21.85

7.6 EVALUATION OF EXOTIC CAULIFLOWER VARIETIES/HYBRIDS SUITABLE FOR 2ND EARLY SEASON IN ADAPTABILITY TRIAL

Six hybrids/varieties, including standard variety FD-II were sown for raising the nursery on 16.07.2019 to check their adaptability. Germination of all the varieties was satisfactory. The trial was laid out according to RCB design with five replications keeping plot size of 5 × 0.75 m. Seedlings of all varieties/hybrid were transplanted in the field at a distance of 45 cm on one side of 75 cm made ridges on 29.08.2019. Standard cultural practices and plant protection measures were carried out regularly. Data regarding plant weight, curd weight, damping off infestation and curd yield of hybrids / varieties was recorded. Plants were rated for damping-off symptoms after sowing on a 0 to 4 scale (0 = healthy roots, 1 = 1-10%, 2=11 - 25%, 3 = 26-50%, and 4 = >50% necrosis of the root system) as done by Abdelzاهر, 2003 for cauliflower. Plants were rated for downy mildew symptoms four week after transplanting on a 0 to 9 scale based on the percentage of symptomatic leaf area (0= No symptoms, 1=3%, 2=6%, 3=12%, 4=25%, 5=50%, 6=75%, 7=87%, 8=94%, 9=99% scale that was based on percentage of symptomatic leaf area.

Table-18 Yield Performance of Cauliflower Hybrid/Varieties (2nd Early-season) during 2019-20

Rank	Genotype	Maturity days	Average Plant Weight (Kg)	Average Curd Weight (Kg)	Damping off	Downy mildew	Yield t/ha
1	HCF-910 B	90-100	2.78	1.23	>50%	0	32.7
2	Sohni	80-90	2.41	0.91	>50%	0	24.4
3	FD-II	60-80	1.68	0.80	>50%	0	21.2
4	HCF-911 A	90-110	1.68	0.71	>50%	0	18.9
5	HCF-900 A	85-100	1.66	0.69	>50%	0	18.3
6	HCF-151 A	85-100	1.67	0.56	>50%	0	15.1
LSD							6.74

0= Completely resistant, 1&2= Highly disease resistant, 3= Moderately disease resistant, 4&5= Intermediate disease 6= Moderately susceptible, 7&8= Highly disease susceptible, 9= Plant dead

The data that is presented in the above table-1 shows that the difference among means due to varieties are statistically significant for Curd yield. HCF-910 B (32.7 t/ha) produced significantly higher yields than check variety FD-II (21.2 t/ha) and variety HCF-151-A (15.05 t/ha) produced the lowest yield among all. Sohni (24.4 t/ha) was at par in comparison with check FD-II (21.2 t/ha) in yield while the entries HCF-911 A (18.9 t/ha), and HCF-900 A (18.3 t/ha) also produced lower yield as compared to check variety FD-II (21.2 t/ha).

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

Set-I

Twenty-three hybrids/varieties including standard variety FD-III were sown for raising the nursery on 02-09-2019 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 in two sets. Seedlings of all varieties/hybrid were transplanted in the field at a distance of 45 cm on one side of 75 cm ridges on 10.10.19 in set-I and set-II. Standard cultural practices were carried out regularly. Data regarding maturity days, plant weight, curd weight, downy mildew, and curd yield of hybrids / varieties was recorded. Maturity days were counted from the date of transplanting to curd formation. Plants were rated for downy mildew symptoms four week after transplanting on a 0 to 9 scale based on the percentage of symptomatic leaf area (0= No symptoms, 1=3%, 2=6%, 3=12%, 4=25%, 5=50%, 6=75%, 7=87%, 8=94%, 9=99% scale that was based on percentage of symptomatic leaf area.

Table-19 Yield performance of Cauliflower Hybrid/Varieties (Mid-Season Set-I) during 2019-20

Rank	Genotype	Maturity days	Average Plant weight kg	Average Curd weight kg	Downy mildew	Yield t/ha
1	Winner BSJ-66	80-100	1.85	1.16	3	33.3
2	Saloni	70-80	1.86	1.07	5	30.6
3	AA Cauli-10	80-100	2.05	1.07	3	30.5
4	AA Cauli H-69	80-100	2.07	1.07	3	30.4
5	CF. 497	90-110	2.30	1.09	0	30.2
6	TCF-605	70-80	1.66	1.04	5	29.6
7	CF.16047	90-100	2.55	1.03	0	29.3
8	TCF-607	80-90	1.63	0.94	5	26.9
9	CF.325	80-90	1.95	0.91	0	26.0
10	AA Cauli H-72	80-100	1.88	0.89	3	25.6
11	TCF-603	70-80	1.99	0.88	5	25.1

12	FD-III	80-90	1.93	0.87	5	24.9
LSD						3.28

0= Completely resistant, 1&2= Highly disease resistant, 3= Moderately disease resistant, 4&5= Intermediate disease 6= Moderately susceptible, 7&8= Highly disease susceptible, 9= Plant dead

The data that is presented in the above table-2 shows that difference among means due to varieties are statistically significant for Curd yield. It is evident from the above table that the entry named Winner BSJ-66 (33.3 t/ha) produced significantly highest curd yield followed by Saloni, AA Cauli-10, AA Cauli H-69, CF.497, TCF-605, CF-16047 while the genotypes TCF-607, CF-325, AA Cauli H-72 and TCF-603 remained statistically at par to check FD-III (24.9 t/ha).

Table-20 Yield performance of Cauliflower Hybrid/Varieties (Mid-Season Set-II) during 2019-20

Rank	Genotype	Maturity days	Average Plant weight kg	Average Curd weight kg	Downy mildew	Yield t/ha
1	AA Cauli-08	100-110	2.61	1.36	2	38.9
2	HCF-930 A	90-110	2.63	1.24	2	35.4
3	CF.385	90-100	2.72	1.23	0	35.2
4	HCF-920 B	90-110	2.67	1.18	3	33.6
5	CF.370	80-90	2.44	1.20	0	33.4
6	CF.16049	90-100	2.48	1.17	0	33.4
7	Winner CF#66	70-90	2.23	1.13	0	32.2
8	AA-82	80-100	2.36	1.11	3	31.7
9	Mumtaz	70-80	2.29	1.07	5	30.7
10	HCF-940 A	70-90	1.86	1.06	2	30.3
11	AA Cauli H-73	80-100	2.06	0.95	3	27.1
12	FD-III	80-90	2.03	0.96	5	23.9
LSD						5.15

0= Completely resistant, 1&2= Highly disease resistant, 3= Moderately disease resistant, 4&5= Intermediate disease 6= Moderately susceptible, 7&8= Highly disease susceptible, 9= Plant dead

The data that is presented in the table-3 shows that difference among means due to varieties are statistically significant for Curd yield. It is evident from the above table that the entries named AA Cauli-08 (38.9 t/ha) produced significantly highest curd yield while the genotypes AA Cauli H-73 (27.1 t/ha) remained statistically at par to check FD-III (23.9 t/ha).

7.8 EVALUATION OF EXOTIC CAULIFLOWER VARIETIES/HYBRIDS SUITABLE FOR LATE SEASON IN ADAPTABILITY TRIAL

Set-I

Twenty one hybrids/varieties including standard variety FD-IV as check were sown for raising the nursery on 15-10-2019 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 in two sets. Seedlings of all varieties/hybrid were transplanted in the field at a distance of 45 cm on one side of 75 cm ridges on 14.11.19 in set-I and set-II. Standard cultural practices were carried out regularly. Data regarding maturity days, plant weight, curd weight, downy mildew, and curd yield of hybrids / varieties was recorded. Maturity days were counted from the date of transplanting to curd formation. Plants were rated for downy mildew symptoms four week after transplanting on a 0 to 9 scale based on the percentage of symptomatic leaf area (0= No symptoms, 1=3%, 2=6%, 3=12%, 4=25%, 5=50%, 6=75%, 7=87%, 8=94%, 9=99% scale that was based on percentage of symptomatic leaf area.

Table-21 Yield performance of Cauliflower Hybrid/Varieties (Late Season Set-I) during 2019-20

Rank	Genotype	Maturity days	Average Plant weight kg	Average Curd weight kg	Downy mildew*	Yield t/ha
1	HCF-971 A	120-130	2.15	1.03	3	31.4
2	HCF-961 A	120-130	1.84	0.99	3	30.1
3	Elgon	120-130	1.78	0.95	3	29.0
4	Snow Queen	120-130	1.51	0.83	3	25.4
5	TCF-609	120-130	1.15	0.77	3	23.4
6	FD-IV	120-130	1.75	0.75	5	22.7
7	Gul Bahar	110-125	1.04	0.63	3	19.3
8	Gulfam	90-120	1.21	0.55	4	16.7
9	Winner-SS#96	80-100	0.77	0.42	3	12.8
10	Diamond CA-03	80-100	0.72	0.27	4	8.3
11	Diamond CA-07	80-100	0.49	0.26	4	7.8
LSD						2.6

*0= Completely resistant, 1&2= Highly disease resistant, 3= Moderately disease resistant, 4&5= Intermediate disease 6= Moderately susceptible, 7&8= Highly disease susceptible, 9= Plant dead

The data that is presented in the above table-1 shows that differences among means due to varieties are statistically significant for yield. It is evident from the above table that the entry named HCF-971 A (31.4 t/ha) produced significantly highest yield while the genotypes Snow Queen and TCF-609 remained statistically at par to check FD-IV (22.7 t/ha).

Table-22 Yield performance of Cauliflower Hybrid/Varieties (Late-Season Set-II) during 2019-20

Rank	Genotype	Maturity days	Average Plant weight kg	Average Curd weight kg	Downy mildew*	Yield t/ha
1	Contessa (Dp-101002)	110-130	1.63	0.97	3	29.5
2	FD-IV	110-125	1.75	0.75	4	22.1
3	Benazir	110-125	1.26	0.67	3	20.5
4	AA Cauli H-82	90-100	0.79	0.50	3	15.3
5	AA Cauli-08	90-100	0.83	0.46	3	14.0
6	AA Cauli H-73	90-100	0.73	0.42	3	12.7
7	Winner-CF#105	90-110	0.64	0.39	3	12.0
8	AA Cauli H-72	90-100	0.76	0.33	3	10.1
9	Winner-CF#94	90-110	0.52	0.28	3	8.4
10	AA Cauli-10	80-100	0.50	0.25	3	7.7
11	AA Cauli H-69	90-110	0.31	0.19	3	5.9
LSD						3.2

*0= Completely resistant, 1&2= Highly disease resistant, 3= Moderately disease resistant, 4&5= Intermediate disease 6= Moderately susceptible, 7&8= Highly disease susceptible, 9= Plant dead

The data that is presented in the table-2 shows that difference among means due to varieties are statistically significant for yield. It is evident from the above table that the entries named Contessa (Dp-101002) (29.5 t/ha) produced significantly highest yield while rest of the genotypes did not produce significantly higher yield from check variety FD-IV (22.1 t/ha).

Set-III

Six hybrids/varieties including standard variety FD-IV were sown for raising the nursery on 04-11-2019 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 in two sets. Seedlings of all varieties/hybrid were transplanted in the field at a distance of 45 cm on one side of 75 cm ridges on 26.12.19 in set-III. Standard cultural practices were carried out regularly. Data regarding maturity days, plant weight, curd weight, downy mildew, and curd yield of hybrids / varieties was recorded. Maturity days were counted from the date of transplanting to curd formation. Plants were rated for downy mildew symptoms four week after transplanting on a 0 to 9 scale based on the percentage of symptomatic leaf area (0= No symptoms, 1=3%, 2=6%, 3=12%, 4=25%, 5=50%, 6=75%, 7=87%, 8=94%, 9=99% scale that was based on percentage of symptomatic leaf area.

Table-23 Yield performance of Cauliflower Hybrid/Varieties (Late-Season Set-III) during 2019-20

Rank	Genotype	Maturity days	Average Plant weight kg	Average Curd weight kg	Downy mildew*	Yield t/ha
1	HCF-971 A	110-130	1.52	0.78	3	23.9
2	HCF-961 A	110-130	1.65	0.73	3	22.3
3	FD-IV	110-130	1.67	0.65	4	19.7
4	Easy Top	110-130	1.19	0.59	3	17.9
5	Bishop RZ	90-100	1.06	0.56	3	16.9
6	Casper RZ	90-100	0.87	0.40	3	12.1
LSD						3.9

*0= Completely resistant, 1&2= Highly disease resistant, 3= Moderately disease resistant, 4&5= Intermediate disease 6= Moderately susceptible, 7&8= Highly disease susceptible, 9= Plant dead

The data that is presented in the table-3 shows that difference among means due to varieties are statistically significant for yield. It is evident from the above table that none of the entry produced significantly higher yield from check variety FD-IV (19.7 t/ha).

8. CABBAGE (*Brassica oleracea* Var. *capitata*)

8.1 EVALUATION OF EXOTIC CABBAGE VARIETIES/HYBRIDS SUITABLE FOR EARLY, MID AND LATE SEASON IN ADAPTABILITY TRIAL Early-Season

Three hybrids/varieties using HCB-1021 A as check were sown for raising the nursery on 29.08.2019. Germination of all the varieties was satisfactory. The trial was laid out according to RCB design with five replications keeping plot size of 5 × 0.75 m. Seedlings of all varieties/hybrid were transplanted in the field at a distance of 45 cm on one side of 75 cm made ridges on 11-10-2019. Standard cultural practices and plant protection measures were carried out regularly. Data regarding field holding capacity, maturity days after transplanting, plant weight, head weight, Downy mildew infestation and yield of hybrids / varieties were recorded. Plants were rated for downy mildew symptoms four week after transplanting on a 0 to 9 scale based on the percentage of symptomatic leaf area (0= No symptoms, 1=3%, 2=6%, 3=12%, 4=25%, 5=50%, 6=75%, 7=87%, 8=94%, 9=99% scale that was based on percentage of symptomatic leaf area.

Table-24 Yield performance of Cabbage Hybrid/Varieties (Early- Season) during 2019-20

Rank	Variety	Field Holding capacity (Days)	Maturity days	Average Plant Weight (kg)	Average Head Weight (kg)	Downy mildew *	Head Yield t/ha
1	HCB-1021 A	25-30	100-120	1.67	1.13	2	33.2

2	HCB-1010 A	20-25	100-120	1.60	1.01	2	29.7
3	HCB-1060 A	25-30	100-120	1.60	0.95	2	28.0
LSD							2.3

*0= Completely resistant, 1&2= Highly disease resistant, 3= Moderately disease resistant, 4&5= Intermediate disease 6= Moderately susceptible, 7&8= Highly disease susceptible, 9= Plant dead

The data presented in the above table shows that differences among means due to varieties are statistically significant for head yield. It is evident from the above table-1 that the entry HCB-1021 A produced significantly highest head yield than rest of the variety.

Mid-Season

Ten hybrids/varieties along with check HCB-142 A were sown for raising the nursery on 15.10.2019 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 21-11-2019. Standard cultural practices and plant protection measures were carried out regularly. Data regarding field holding capacity, maturity days after transplanting, plant weight, head weight, head weight, Downy mildew infestation and yield of hybrids / varieties were recorded. Plants were rated for downy mildew symptoms four week after transplanting on a 0 to 9 scale based on the percentage of symptomatic leaf area (0= No symptoms, 1=3%, 2=6%, 3=12%, 4=25%, 5=50%, 6=75%, 7=87%, 8=94%, 9=99% scale that was based on percentage of symptomatic leaf area.

Table-25 Yield performance of Cabbage Hybrid/Varieties (Mid- Season) during 2019-20

Rank	Variety	Field Holding capacity (Days)	Maturity days	Average Plant Weight (kg)	Average Head Weight (kg)	Downy milde w*	Head Yield t/ha
1	HCB-1040 B	20-30	120-140	1.59	1.07	1	44.8
2	TCG-1401	20-30	120-130	1.42	0.95	2	39.9
3	HCB-1031 A	20-30	110-120	1.42	0.94	1	39.3
4	HCB-1051 A	20-30	100-120	1.42	0.93	2	38.8
5	HCB-142 A	20-30	110-120	1.47	0.95	2	38.3
6	HCB-1041 A	20-25	100-120	1.45	0.90	2	37.8
7	Chaman	20-25	110-120	1.45	0.89	3	37.3
8	Silver	25-30	110-120	1.24	0.81	3	33.8
9	Zartaj	25-30	100-120	1.26	0.78	2	32.7

10	HCB-1061 A	20-30	100-120	1.09	0.68	2	28.4
LSD							5.6

* 0= Completely resistant, 1&2= Highly disease resistant, 3= Moderately disease resistant, 4&5= Intermediate disease 6= Moderately susceptible, 7&8= Highly disease susceptible, 9= Plant dead

The data presented in the above table shows that differences among means due to varieties are statistically significant for head yield. It is evident from the above table that the entry HCB-1040 B produced significantly higher head yield (44.8 t/ha) than check varieties HCB-142 A (38.3 t/ha). Lowest head yield was recorded in HCB-1061 A (28.4 t/ha).

Late Season

Six hybrids/varieties along with check HCB-142 A were sown for raising the nursery on 4.11.2019 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 26-12-2019. Standard cultural practices and plant protection measures were carried out regularly. Data regarding field holding capacity, maturity days after transplanting, plant weight, head weight, head weight, Downy mildew infestation and yield of hybrids / varieties were recorded. Plants were rated for downy mildew symptoms four week after transplanting on a 0 to 9 scale based on the percentage of symptomatic leaf area (0= No symptoms, 1=3%, 2=6%, 3=12%, 4=25%, 5=50%, 6=75%, 7=87%, 8=94%, 9=99% scale that was based on percentage of symptomatic leaf area.

Table-26 Yield performance of Cabbage Hybrid/Varieties (Late- Season) during 2019-20

Rank	Variety	Field Holding capacity (Days)	Maturity days	Average Plant Weight (kg)	Average Head Weight (kg)	Downy mildew *	Head Yield t/ha
1	CHAMP	20-30	120-140	1.20	0.92	2	38.5
2	Disha	20-30	120-140	1.47	0.88	2	37.0
3	HCB-142 A	20-30	110-120	1.13	0.80	2	33.4
4	HCB-1051 A	20-30	110-120	1.20	0.80	2	33.4
5	HCB-1031 A	20-30	110-120	1.17	0.76	1	31.7
6	Tropicana	10-20	120-140	0.72	0.47	3	19.9
	LSD (0.05)						3.9

* 0= Completely resistant, 1&2= Highly disease resistant, 3= Moderately disease resistant, 4&5= Intermediate disease 6= Moderately susceptible, 7&8= Highly disease susceptible, 9= Plant dead

The data presented in the above table shows that differences among means due to varieties are statistically significant for head yield. It is evident from the above table that the entry CHAMP produced significantly higher head yield (38.5 t/ha) than check varieties HCB-142 A (33.4 t/ha). Lowest head yield was recorded in Tropicana (19.9 t/ha) as 43 % of the plants were bolted and not able to form marketable head.

9. BROCCOLI (*Brassica oleracea* Var. *italica*)

Two hybrids/varieties including standard variety BVRI-18 as check were sown for raising the nursery on 15-10-2019 to check their adaptability. Germination of all the varieties was satisfactory. The trial was laid out in pair plot and two ridges of size 7 × 0.75 m were made in each plot. Seedlings of all varieties/hybrid were transplanted in the field at a distance of 45 cm on one side of 75 cm ridges on 14.11.19. Standard cultural practices were carried out regularly. Data regarding maturity days, head weight, downy mildew, and yield of hybrids / varieties was recorded. Maturity days were counted from the date of transplanting to curd formation. Plants were rated for downy mildew symptoms four week after transplanting on a 0 to 9 scale based on the percentage of symptomatic leaf area (0= No symptoms, 1=3%, 2=6%, 3=12%, 4=25%, 5=50%, 6=75%, 7=87%, 8=94%, 9=99% scale that was based on percentage of symptomatic leaf area.

Table-27 Yield performance of Broccoli Hybrid/Varieties during 2019-20

Rank	Genotype	Maturity days	Average Curd weight Kg	Downy mildew*	Yield t/ha
1	HBC-300 A	90-100	0.60	3	16.5
2	BVRI-18	90-100	0.31	3	10.5
T-value					2.77

*0= Completely resistant, 1&2= Highly disease resistant, 3= Moderately disease resistant, 4&5= Intermediate disease 6= Moderately susceptible, 7&8= Highly disease susceptible, 9= Plant dead

The data that is presented in the above table shows that difference among means due to varieties are statistically significant for yield. It is evident from the above table that the entry named HBC-300 A (16.5 t/ha) produced significantly higher yield than check BVRI-18 (10.5 t/ha).

10. ONION (*Allium cepa* L.)

10.1 MAINTENANCE OF GERMPLASM

Thirty genotypes of Onion of local and exotic origin were sown for the purpose of maintenance in the previous season and their bulbs were stored. Bulbs were transplanted in

Isolation chambers for seed production on 09.11.2019 keeping plot size 30 X 5 m. At flowering pollination was done manually with brushes to ensure maximum seed setting under insect net. Seed was harvested at maturity and saved for future use.

The detailed below entries were maintained during the year:

Table-28 Maintenance of Onion germplasm

Sr. No	Entry	Sr. No	Entry
1	W.P-19	16	T.E.G-17
2	VRIO-2	17	Pusa Red
3	VRIO-3	18	G.O.R.B-17
4	VRIO-4	19	VRIO-16
5	VRIO-5	20	Sultan
6	VRIO-6	21	VRIO-15
7	VRIO-7	22	Phulkara
8	VRIO-8	23	VRIO-17
9	VRIO-9	24	VRIO-18
10	VRIO-10	25	VRIO-19
11	VRIO-11	26	VRIO-20
12	Sultan-19	27	VRIO-21
13	Desi Red	28	VRIO-22
14	Red Imposta	29	White Pearl
15	VRIO-23	30	W.P-17

10.2 EVALUATION OF EXOTIC ONION VARIETIES / HYBRID IN ADAPTABILITY TRIAL CONDUCTED DURING RABI SEASON 2019-20

Eighteen varieties/hybrids received from different seed companies were tested along with check (Phulkara and Sultan) for their performance in adaptability trial at vegetable research institute, Faisalabad during rabi season 2019-20. The nursery was sown on 25.10.2019 and transplanted on 23.12.2019 in the field according to Randomized Complete Block Design with three replications. The plot size was kept as 6 × 1.2 m. All cultivars were transplanted on both sides of 60 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 18.05.2019 and bulb yield data were recorded and presented in the following Table.

Table-29 Yield performance of Exotic Onion Varieties/Hybrids in Adaptability Trial conducted at VRI, Faisalabad

Entries	Yield (t/ha)	Downy mildew (%)	Leaf Blight (%)	Purple Blotch (%)
HON-300A	51.43	5	10	0
HON-304E	48.89	4	12	0
NR1	47.42	5	9	5
HON-302C	45.71	4	12.5	2.5
Kessar	42.45	6.5	8.5	1.5
Rosabella	39.52	4.3	11	1
Glory	37.16	6.7	10	3
CBS-130	35.04	7	10.8	2
Gulzar	33.78	8	15	2
GSL-132	33.73	6	17	0
Sultan	33.24	6	12.5	0
HON-301B	32.43	5	14	2.5
HON-303D	32.35	5	12.8	3
ON1215	29.33	12	24	6
Phulkara	27.05	10	20	4
Tarzan	26.64	11.5	26.5	9
No.96	25.59	14	24	8.6
No.84	25.42	10.5	25	7
LSD (0.05)	7.2			

The data presented in the above table reveals that differences among means due to varieties were significant for bulb yield. Entry HON 300A (51.43 t/ha), HON 304E (48.89 t/ha) and NR1 (47.42 t/ha) came on first, second and third position with highest yield. Sultan (check) came on eleven number with yield 27.05 t/ha. The varieties No. 96 and No.84 produces the lowest yield 25.59 and 25.42 t/ha respectively.

10.3 NUYT ON ONION CONDUCTED AT VEGETABLE RESEARCH INSTITUTE, FAISALABAD DURING RABI 2019-20

Three genotypes of Onion received for NUYT from Pakistan Agriculture Research Centre (Plant Science Division), National Agriculture Research Centre, Islamabad were tested with three approved varieties at Vegetable Research Institute, Faisalabad. The trial was laid out according to RCB design with three replications. Nursery was sown on 30-10-2018 and transplanted on 19-11-2019 and transplanted on 09-01-2020. The planting geometry of the trial was kept according to given instructions. Standard cultural practices and plant protection measures were adopted. The trial was harvested on 19-05-2010. Data of the recorded parameters is presented in the following table.

Table-30 Average data of NUYT of Onion 2019-20

Entries	Bulb weight	Yield (kg/plot)	Yield (t/ha)	Bolting (%)	Days to maturity*
Sultan	155.00	17.05	47.36	0	180
White Pearl	127.67	14.04	39.01	0	180

Phulkara	126.00	13.86	38.50	0	180
ON19008	114.33	12.58	34.94	0	180
ON19009	106.67	11.73	32.59	0	180
ON19002	95.67	10.52	29.23	0	180
LSD (0.05)	6	0.6	1.8		

All the genotypes showed significant differences for bulb weight and yield. Sultan produced highest yield followed by white pearl. Genotypes ON19002 produced lowest yield.

Note *: Days to maturity were same for all the genotypes as it is a bulb crop and whole trial is planted and harvested on same date.

10.4 EVALUATION OF CANDIDATE ONION GENOTYPES IN YIELD TRIALS

Six genotypes of onion including Phulkara (check) were tested in a yield trial at Faisalabad. The nursery was sown on 25.10.2019 and transplanted on 23.12.2019 in the field according to Randomized Complete Block Design with three replications. The plot size was kept as 6 × 1.2 m. All cultivars were transplanted on both sides of 60 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 18.05.2019 and data of bulb diameter, bulb weight, bulb yield, neck diameter and number of rings per bulbs were recorded and presented in the following Table.

Table-31 Performance of Onion genotypes in yield trial at VRI, Faisalabad during Rabi 2019-20

Entries	Bulb Weight (g)	Bulb Diameter (cm)	Neck Diameter (cm)	Yield (t/ha)
VRIO-14	205	9.0	0.5	40.40
Sultan	142.33	7.39	0.99	32.56
Phulkara	136.00	7.35	1.21	31.19
White Pearl	133.00	7.12	1.1	29.40
VRIO-11	132.33	6.9	1.01	28.25
VRIO-13	131.67	6.25	1.5	27.96
LSD (.05)	22.19	0.37	0.19	5.05

Highly significant differences were observed among the genotypes for yield and other studied characters. The genotype VRIO-14 stood first among the tested genotypes for yield (40.40 t/ha), Bulb weight (205 g) and bulb diameter (9 cm). Lowest yield was produced by VRIO-13 (27.96 t/ha) as shown in above table.

11. **OKRA (*Abelmoschus esculentus* L.)**

11.1 REPORT ON OKRA EXOTIC VARIETIES/HYBRIDS IN ADAPTABILITY TRIAL CONDUCTED AT VRI, FAISALABAD DURING KHARIF 2020

Eleven exotic varieties/hybrids imported by seed companies were tested to check their adaptability along with two check varieties “Sabz Pari and OK-1900”. 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 25-02-2020. 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 27-04-2020 and continued till 08-07-2020. Data regarding fresh fruit yield was recorded and presented in the following table.

Table-32 Yield performance of exotic okra hybrids/varieties in adaptability trial conducted at VRI Faisalabad during kharif, 2020 (set-I)

Sr. No.	Variety	Disease % (Cercospora Leaf Spot)	Disease % (Damping Off)	Fresh fruit yield (t/ha)
1	Okra Jiya	0	10	21.36
2	OH-3312	0	10	20.36
3	Okra Zuni	0	10	19.77
4	OK-1900(C)	0	05	19.23
5	SVOK-0001	0	20	18.78
6	HO-46 E	0	15	18.45
7	Sabz Pari (C)	0	10	18.34
8	SVOK-5151	0	15	18.32
9	Advanta F ₁ -828	0	20	18.25
10	Okra Fresh-01	0	25	17.73
11	BS-782	10	25	17.21
12	Okra Sohni	15	20	16.77
13	Karishma-121	10	25	16.65
	LSD (0.05)			1.75

The data presented in the above table shows that only Okra Jiya (21.36 t/ha) variety is significantly different from check OK-1900 for fresh fruit yield while Okra Jiya and OH-3312 is significantly different from standard variety Sabz Pari (18.34 t/ha). The lowest yield was recorded in Karishma-121 (16.65 t/ha).

Table-33 Yield performance of exotic okra hybrids/varieties in adaptability trial conducted at VRI Faisalabad during kharif, 2020 (set-II)

Sr. No.	Variety	Disease % (Cercospora Leaf Spot)	Disease % (Damping Off)	Fresh fruit yield (t/ha)
1	AA-OK-31	0	15	26.97
2	Diamond-2525 F ₁	0	15	26.71
3	Diamond-2626 OP	0	10	26.10
4	OK-1900 (C)	0	10	26.02

5	AA-OK-33	0	15	25.51
6	Sabz Pari (C)	0	10	25.39
7	AA-OK-32	0	20	25.01
8	Sahara-130 F ₁	10	20	24.94
9	Sahara-7205 OP	10	15	23.94
10	AA-OK-34	0	20	23.84
11	AA-OK-39	10	15	21.96
12	TOK-1201	15	20	21.79
13	TOK-1202	15	25	21.49
	LSD (0.05)			1.26

The data presented in the above table shows that no variety is significantly different from check OK-1900 for fresh fruit yield while AA-OK-31 and Diamond-2525 F₁ with fruit yield of 26.97 and 26.71 t/ha gave significant higher fresh fruit yield than standard variety Sabz Pari (23.22 t/ha). The lowest yield was recorded in TOK-1202 (21.49 t/ha).

12. CUCUMBER (*Cucumis sativus* L.)

12.1 ADAPTABILITY REPORT OF CUCUMBER VARIETIES/ HYBRIDS UNDER HIGH TUNNEL IN DRIP IRRIGATION CONDUCTED AT VEGETABLE RESEARCH INSTITUTE, FAISALABAD DURING 2019-20

Eighteen hybrids/varieties including AC-1805 as check were sown on 18-11-2019 to check their adaptability under high tunnel in set-I. To assure required plant population gap filling was done where needed. The trial was laid out according to randomized complete block design with three replications. Plot size was maintained as 5.8 × 0.75 m and plant to plant distance was 30 cm. Standard cultural practices were carried out regularly. Fruit picking was started on March 03, 2020 and continued up to May 15, 2020. Total twenty pickings were taken from trial. Data regarding yield, number of fruits and disease was recorded and analyzed statistically which is presented in the following table 1. Plants were rated for cucumber mosaic virus (CMV) symptoms on 0 to 5 scale based on percentage i.e. 1=Highly resistant (no symptoms; 0% - 10% infection); 2= Resistant (vein clearing after some time; 11% - 20%); 3= Moderately resistant (vein clearing and mild mottle; 21% - 30%); 4= Moderately susceptible (mild mosaic on few leaves; 31% - 40%); 5= Susceptible (mosaic, wrinkling, mottling; >60%).

Table-34 Performance of Cucumber Hybrid/Varieties under High Tunnel at VRI Faisalabad during 2019-20 (Set-I)

Rank	Hybrid / Varieties	No. of fruits/ plant	CMV %	Avg. yield t/ha
1	Maxwell	16	2	116.1
2	Liner	13	2	103.8
3	Hashim- F ₁	15	3	100.6

4	TCB-803	12	3	85.2
5	TCB-801	11	3	83.1
6	AC-1805	13	2	82.8
7	Prince Star RZ	11	2	79.2
8	TCB-802	10	3	76.3
9	Yielder	11	2	73.6
10	HCU-1171 B	9	2	62.0
11	Winner-KJ #8	8	1	58.9
12	OZ	9	4	57.7
13	DP-01	8	2	56.4
14	Sahar- F1	7	1	54.6
15	Subhan F1	5	4	35.8
16	Winner-SPA #2	5	2	32.0
17	Winner-N 7001	4	2	27.1
18	Winner-V 55	4	2	24.1
LSD				14.4

The data that is presented in the above table 1 shows that difference among means due to varieties are statistically significant for yield. It is evident from the above table that the entries Maxwell (116.1 t/ha), Liner (103.8 t/ha), and Hashim- F₁ (100.6 t/ha) produced significantly higher yield than check AC-1805 (82.8 t/ha) while TCB-803 (85.2) and TCB-801 (83.1) remained statistically at par to check AC-1805 (82.8 t/ha).

Set-II

Seven hybrids/varieties including AC-1805 as check were sown on 09-12-2019 to check their adaptability under high tunnel in set-II. To assure required plant population gap filling was done where needed. The trial was laid out according to randomized complete block design with three replications. Plot size was maintained as 5.8 × 0.75 m and plant to plant distance was 30 cm. Standard cultural practices were carried out regularly. Fruit picking was started on March 10, 2020 and continued up to May 15, 2020. Total nineteen pickings were taken from trial. Data regarding yield, number of fruits per plant and disease was recorded and analyzed statistically which is presented in the following table 2. Plants were rated for cucumber mosaic virus (CMV) symptoms on 0 to 5 scale based on percentage i.e. 1=Highly resistant (no symptoms; 0% - 10% infection); 2= Resistant (vein clearing after some time; 11% - 20%); 3= Moderately resistant (vein clearing and mild mottle; 21% - 30%); 4= Moderately susceptible (mild mosaic on few leaves; 31% - 40%); 5= Susceptible (mosaic, wrinkling, mottling; >60%).

Table-35 Yield Performance of Cucumber Hybrid/Varieties under High Tunnel at VRI Faisalabad during 2019-20 (Set-II)

Rank	Hybrid / Varieties	No. of fruits/ plant	CMV %	Avg. yield t/ha
1	CBS-552	31	2	182.8
2	GSL-550	29	2	173.0

3	CU-1353	26	2	154.4
4	CU-1947	24	3	154.1
5	CU-6530	21	2	129.7
6	CU-1549	19	1	125.9
7	AC-1805	16	2	92.5
LSD				14.8

The data that is presented in the above table 2 shows that difference among means due to varieties are statistically significant for yield. It is evident from the above table that all the entries produced significantly higher yield than check AC-1805 (92.5 t/ha).

12.2 ADAPTABILITY REPORT OF CUCUMBER VARIETIES/ HYBRIDS IN OPEN FIELD CONDUCTED AT VEGETABLE RESEARCH INSTITUTE, FAISALABAD DURING 2019-20

Ten hybrids/varieties including KHEERA LOCAL as check were sown on 20-02-2020 to check their adaptability in open field. To assure required plant population gap filling was done where needed. The trial was laid out according to randomized complete block design with three replications. Plot size was maintained as 4 × 2.5 m and plant to plant distance was 30 cm. Standard cultural practices were carried out regularly. Fruit picking was started on April 20, 2020 and continued up to June 05, 2020. Total ten pickings were taken from trial. Data regarding yield, number of fruits and disease was recorded and analyzed statistically which is presented in the below table. Plants were rated for cucumber mosaic virus (CMV) symptoms on 0 to 5 scale based on percentage i.e. 1=Highly resistant (no symptoms; 0% - 10% infection); 2= Resistant (vein clearing after some time; 11% - 20%); 3= Moderately resistant (vein clearing and mild mottle; 21% - 30%); 4= Moderately susceptible (mild mosaic on few leaves; 31% - 40%); 5= Susceptible (mosaic, wrinkling, mottling; >60%).

Table-36 Yield Performance of Cucumber Hybrid/Varieties in Open field at VRI Faisalabad during 2019-20

Rank	Hybrid / Varieties	No. of fruits/ plant	CMV %	Avg. yield t/ha
1	Glossy	3	3	12.4
2	French green	4	2	11.0
3	SSP #12	3	2	10.5
4	HCU-175 D	3	2	10.3
5	TCB-801	3	3	9.1
6	HCU-170 B	3	3	9.1
7	RS 03643519	2	3	9.0
8	Valley	2	3	8.1
9	Ever green	3	1	8.0
10	KHEERA LOCAL	2	1	7.1
LSD (0.05)				2.9

The data that is presented in the above table shows that difference among means due to varieties are statistically significant for yield. It is evident from the above table that the entries Glossy (12.4 t/ha), French green (11.0 t/ha) and SSP #12 (10.5 t/ha) produced significantly higher yield than check KHEERA LOCAL (7.1 t/ha) while HCU-175 D (10.3 t/ha), TCB-801 (9.1 t/ha), HCU-170 B (9.1 t/ha), RS 03643519 (9.0 t/ha), Valley (8.1 t/ha) and Ever green (8.0 t/ha) remained statistically at par to check KHEERA LOCAL (7.1 t/ha).

13. BOTTLE GOURD

13.1 MAINTENANCE OF BOTTLE GOURD GERmplAM

The seed of six genotypes/varieties namely Faisalabad Round, No. 2075, GU44071, I-150, Savera and VRIBG-2 was sown in nursery trays during 2nd week of November 2019. Then these were transplanted under high plastic tunnel. At the time of flowering, pollen of each line was collected and female flowers of respective line was pollinated. Seed was extracted from fruits, resulting from manual pollination. The seed was dried and transferred to Vegetable Research Station, Karor for further studies.

13.2 DEVELOPMENT OF OPEN POLLINATED VARIETY OF BOTTLE GOURD

Seed of these fruits was extracted and stored for sowing in isolation according to their progenies were sown. The seed was transferred to Vegetable Research Station, Karor for further studies.

13.3 ADAPTABILITY TRIAL ON BOTTLE GOURD IN OPEN FIELD AT VEGETABLE RESEARCH INSTITUTE FAISALABAD DURING KHARIF 2020

Fifteen Bottle gourd varieties namely Green King, 2075, Green Baby, HBO-240 B, HBO-241 C, Diamond 2020, Diamond 2121, HBO-370 B, HBO-371 C, Diamond 2030, Sahara-512 P, VRIBG-02, Sahara 2020, Green Pearl, Bumper F₁ along with Faisalabad Round (Check) were sown in open field on March 12, 2020. Some seeds were not germinated from different varieties. To assure better germination re-sowing was done of those varieties whose germination was not up to mark in first sowing. The trial was conducted on the field where radish crop was harvested and due to exhaustive crop the germination of the bottle gourd crop was not up to the mark. The trial was laid out according to randomized complete block design (RCBD) with three replications. Plot size was maintained as 6 x 3.5 m with three replications and plant to plant distance was 50 cm. Fruits picking was started on May 06, 2020 and lasted up to August 12, 2020. Total thirty pickings were taken from the trial. Standard cultural practices and plant protection measures were carried out to the trial. Data regarding germination %age, No. of fruits/ plant, fruit yield (t/ha) were recorded and analyzed statistically which are presented in the following table.

Table-37 Performance of bottle gourd hybrids/varieties in an adaptability trial In open field at Vegetable Research Institute, Faisalabad

Rank	Varieties	Germination (%)	No. of fruits/plant	Fruit yield (t/ha)
1	Bumper F ₁	95.0	12.7	59.1
2	Green Pearl	98.3	8.5	39.5
3	Sahara 2020	95.0	7.9	37.4
4	Diamond 2020	93.3	7.8	36.2
5	Green King	96.7	7.9	35.9
6	HBO-241C	93.3	7.4	33.5
7	HBO-240B	96.7	7.2	33.0
8	HBO-371C	91.7	7.3	32.4
9	HBO-370B	93.3	7.2	31.3
10	No. 2075	96.7	7.0	30.6
11	Green Baby	93.3	7.3	30.6
12	Diamond 2121	96.7	6.3	27.1
13	Diamond 2030	90.0	6.3	26.9
14	Faisalabad Round (Check)	91.7	6.0	24.8
15	VRIBG-02	91.7	5.8	23.4
16	Sahara-512 P	95.0	5.7	23.2
	LSD 5%	NS	1.4	7.3

The data in the above table revealed that germination %age ranges from 90% (Diamond 2030) to 98.3% (Bumper F₁). Germination percentage was excellent in all the varieties. 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 12.7 (Bumper F₁) followed by 8.5 (Green Pearl) and 7.9 (Green King and Sahara 2020) whereas the lowest numbers of fruits per plant recorded were 5.8 which is of variety VRIBG-02, perhaps due to cylindrical shape of fruit. The hybrid Bumper F₁ produced highest yield (59.1 t/ha) followed by Green Pearl (39.5 t/ha) and Sahara 2020 (37.4 t/ha) whereas variety Sahara 512 P produced the lowest fruit yield of 23.2 t/ha. 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. Varieties/Hybrids Bumper F₁ and Green Pearl started fruiting from 1st week of May and their bearing continued till last.

Regarding disease infestation, grey mold disease infestation was observed on all the bottle gourd varieties/hybrids which had been controlled by the sprays of effective fungicides. This shows that none of the varieties/hybrids was resistant against the said disease.

14. **BRINJAL (*Solanum melongena* L.)**

14.1 **EVALUATION OF BRINJAL VARIETIES/HYBRIDS IN ADAPTABILITY TRIAL DURING AUGUST, 2019**

The seed of nine brinjal entries including checks were sown on 05-07-2019 for raising the nursery and seedlings were transplanted in the field on 01-08-2019. The trial was laid out according to Randomized Complete Block Design with three replications in a plot size of 4.5 x 1.5m. The seedlings were transplanted with plant to plant distance of 50 cm. Standard cultural practices and plant protection measures were adopted. The data for fruit yield and disease incidence percentage (Stem Phylum Leaf Blight and Alternaria Leaf Blight) is given in the table below;

Table-38 Performance of Brinjal Entries during Kharif- 2019

Sr. No.	Genotypes	Fruit Colour	Fruit Shape	Yield (T/ha)	Disease Incidence %	
					SPL	ALB
1	Sangeet-F ₁	Black	Oblong	26.9	25	40
2	Nova	Dark Purple	Long	26.7	25	40
3	LBH-021	White	Oblong	22.9	20	25
4	TBJ-1302	Black	Oblong	20.3	15	20
5	Nirala (Oblong Check)	Purple	Oblong	20.3	30	30
6	Jhanak-F ₁	Black	Oblong	19.6	15	25
7	Bemissal (Long Check)	Dark Purple	Long	19.5	30	10
8	TBJ-1301	Dark Purple	Oblong	16.3	15	0
9	Dilnasheen (Round Check)	Black	Round	8.0	0	30
LSD (0.05)				10.0		

The data shown in the above table reveals that entries Sangeet-F₁, LBH-021(Local Brinjal Hybrid) and TBJ-1302 surpassed Nirala (Oblong Check) while entries Jhanak-F₁ and TBJ-1301 were below the Nirala (Oblong Check). Long entry Nova was found to be high as compared to Bemissal (Long Check).

15. **PUMPKIN**

15. **EVALUATION OF PUMPKIN VARIETIES/HYBRIDS IN ADAPTABILITY TRIAL DURING 2020**

The seeds of five Pumpkin entries including check were sown on 24-02-2020 in the field. The trial was laid out according to Randomized Complete Block Design with three

replications in a plot size of (5m x 5m) with Plant to Plant distance of 60cm. Standard cultural practices and plant protection measures were adopted. The data recorded for fruit yield, average fruit weight and disease incidence is given in the table below;

Table-39 Performance of Pumpkin Entries during 2019

Sr. No.	Genotypes	Fruit Yield (T/ha)	Average Fruit Weight (Kg)	Disease Incidence
1	HPK-820A	41.99	3.30	Cucumber Mosaic Virus (10%), Grey Mold (20%)
2	PHK-1591	20.47	2.86	Grey Mold (20%)
3	PHK-1050	18.65	3.22	Grey Mold (30%), Downy Mildew (20%)
4	Pumpkin Local (Check)	14.20	2.72	Cucumber Mosaic Virus (30%), Grey Mold (30%)
LSD (0.05)		11.36	1.15	

The data shown in the above table reveals that all the entries for fruit yield are statistically at par. The entry HPK-820A showed highest average fruit weight (3.30Kg) while Pumpkin Local (Check) showed the lowest average fruit weight (2.72Kg). As far as disease incidence is concerned all the entries were susceptible to Grey Mold disease and two entries HPK-820A and Local (Check) showed the incidence of Cucumber Mosaic Virus. Incidence of Downy Mildew (20%) was observed on PHK-1050.

16. GARLIC (*Allium sativum*)

16.1 COLLECTION AND EVALUATION OF DIFFERENT CLONES OF GARLIC 2019-20

The trial was conducted to evaluate the performance of five clones of Garlic viz, G-1901, G-1902, G-1903, G-1904 and Lehsan Gulabi using as check. The layout of trial was made according to RCB design in three replications. The sowing of the clones was made on 07-10-2019 in lines keeping plant to plant and row to row distance of 10cm and 20cm respectively in a plot size 35 × 2 m. All agronomic and plant protection measures were adopting accordingly. The crop was observed closely to record the morphological traits of the clones at harvest which are given in table below;

Table-40 List of clones

Sr. No.	Clones	No. of Cloves/ Blub	Average Bulb Weight (g)	Yield (t/ha)
1	G-1901	5-6	55-60	13.14
2	G-1902	5-9	40-45	6.60
3	G-1903	5-9	35-40	6.36
4	G-1904	30-35	30-35	5.33

5	Lehsan Gulabi	20-25	20-25	4.43
(LSD 0.05)				0.27

The above data reveals that the clone G-1901 gave the highest bulb yield (13.14 t/ha) followed by G-1902 with yield value of (6.60 t/ha) and G-1903 with yield of (6.36 t/ha). The different among the clones are significant.

17. SPINACH (*Spinacia oleracea*)

17.1 MAINTENANCE OF GENEPOOL IN SPINACH

About 5 marlas each of S-01-19, S-02-19, S-03-19 and desi palak were sown on 10-10-2019 in rows 75 cm apart in isolation. After germination, crop was thinned keeping plant to plant distance of 10 cm. At the height of 15-20 cm, Plants were keenly observed regarding leaf and stem color. The plants having redness at the base and red color midrib were rogued out. At bolting stage, all early bolters were also rogued out. Remaining full green and late bolting plants were kept to produce BNS Seed.

17.2 ADAPTABILITY TRIAL OF SPINACH VARIETIES/HYBRIDS CONDUCTED AT VRI, FAISALABAD DURING RABI 2019-20

The trial was conducted to evaluate the performance of four varieties of spinach viz; S-01-19, Sawwad, ES-1231A and Desi Palak using Desi Palak as check. The layout of the trial was made according to RCB design in three replications. The sowing of the varieties was done on 16.10.2019 at ridges made 75 cm apart in a plot size of 5.5 x 1.5 m. All agronomic and plant protection measures were adopted to maintain the crop. Three cuttings were taken first on 29.11.2019, second on 30.12.2019 and third on 30.01.2020. No incidence of any disease was found throughout the crop duration. The data recorded for leaf yield and other characteristics is presented in the table below.

Table-41 Performance of Spinach Varieties at VRI, Faisalabad during 2019-20

Sr. No.	Varieties	No. of leaves / plant	Leaf length (without petiol) (cm)	Leaf width (cm)	Leaf yield (t/ha)
1	S-01-19	15-20	20-25	13-18	101.7
2	Sawwad	10-15	20-25	10-15	100.6
3	ES-1231-A	10-15	15-20	8-10	97.2
4	Desi Palak	10-15	10-15	8-10	71.0
	LSD(0.05)				2.1

The above data reveals that variety S-01-19 gave the highest leaf yield (101.7 t/ha.) followed by Sawwad with yield value of 100.6 t/ha and ES-1231-A with 97.2 t/ha. The differences among the varieties are highly significant.

18. CORIANDER (*Coriandrum sativum*)

18.1 DEVELOPMENT OF CORIANDER VARIETIES FOR LATE BOLTING

The seed of random mating population was sown in the field on 10-10-2019. On attaining the sufficient growth, the plants having broad leaves and more number of leaves were selected. At bolting stage, plants having late bolting behavior were selected. Then they were allowed to random mate. The seed was harvested and bulked for next generation. Thus the first cycle is completed.

18.2 ADAPTABILITY TRIAL OF CORIANDER VARIETIES/HYBRIDS CONDUCTED AT VRI, FAISALABAD DURING RABI 2019-20

The trial was conducted to evaluate the performance of four varieties of Coriander viz; Kandhari, ECO-1212-A, C-F₁ and Dilpazeer using as check. The layout of the trial was made according to RCB design in three replications. The sowing of the varieties was done on

17.10.2019 at ridges made 75 cm apart in a plot size of 5.5 x 1.5 m. All agronomic and plant protection measures were adopted to maintain the crop. Two cuttings were taken first on 21.01.2020 and second on 02.03.2020. There is no incidence of any disease was observed throughout the crop duration. The data recorded for leaf yield and other characteristics is presented in the table below.

Table-42 Performance of Coriander varieties at VRI, Faisalabad during 2019-20

Rank	Varieties	No. of leaves / plant	Leaf Yield (t/ha)
1	C-F1	7-10	33.1
2	ECO-1212-A	7-10	31.6
3	Kandhari	5-7	29.6
4	Dilpazeer	5-7	27.6
LSD (0.05)			1.88

The above data reveals that variety C-F1 gave the highest leaf yield (33.1 t/ha.) followed by ECO-1212-A with yield value of 31.6 t/ha whereas the lowest yield was recorded in variety Dilpazeer with value of 27.6 t/ha. The differences among the varieties are highly significant.