

Annual Report 2019-20



**Potato Research Institute
Sahiwal**

Table of Contents

Sr. No.	Title of Content	Page
01	Introduction	01
02	Technical staff position	02
03	Maintenance of germplasm	03
04	Evaluation of Potato Strains/Varieties against Frost Incidence at PRI, Sahiwal.	03
05	Evaluation of Potato Strains/Varieties against Frost Incidence at BARI, Chakwal.	04
06	Zonal varietal yield trial at PRI, Sahiwal	05
07	Zonal varietal yield trial at BARI, Chakwal	06
08	Zonal varietal yield trial at CRI, Multan	06
09	Zonal varietal yield trial at PRS, Sahowali (Sialkot)	07
10	National Uniform Potato Yield Trial.	08
11	National Uniform Potato Yield Trial for dry matter at PRI, Sahiwal.	13
12	Adaptability Trials of Exotic Potato Varieties Imported by Different Seed Companies during 2019-20	14
13	Early Bulking Potato Yield Trial	19
14	Evaluation of potato varieties against varied irrigation regimes	20
15	Seed increase of approved varieties of potato	21
16	Seed increase of promising lines of potato	21
17	Minitubers production of approved potato varieties through Tissue Culture	21
18	Distinctive Uniformity Stability test of promising potato lines	22
19	Spot examination of candidate potato varieties	22
20	Inter provincial yield trial of approved potato varieties at PRI, Sahiwal	22
21	Potato Research Station, Sahowali (Sialkot)	23
22	Station-wise detail of area	23
23	Manpower	24
24	Main research activities	24
26	Weather and its effects	25
27	Preliminary evaluation of crossed material during autumn, 2019-2020	26
28	Secondary Evaluation of Sixteen Red and White potato Strains/ Varieties for their Yield Potential and other desirable traits 2019-20	27
29	Regular Varietal Yield Trials with New Potato Strains/Varieties 2019-20	28
30	Potato Breeding Research Sub-Station, Murree	29
31	Hybridization	29
32	Selection of desirable genotypes from crosses of 2017.	30
33	PLANT PATHOLOGY	36
34	Potato Research Institute, Sahiwal	36
35	Effect of seed treatment for the management of Rhizoctonia disease of potato.	36
36	Testing of different doses of Fludioxonil for the control of common scab disease in Potato.	37
37	Effect of Irrigation frequency on the incidence of common scab	38
38	Potato Research Station, Sahowali (Sialkot)	38
39	Evaluation of thirty promising local genotypes for resistance/tolerance against foliar and tuber diseases.	38
40	Control of Late Blight of Potato Through Different Fungicides	41

41	Chemical Control of Black Scurf (Rhizoctonia Sp) Through Seed Treatment.	42
42	AGRONOMY	43
43	Potato Research Institute, Sahiwal	43
44	Impact of Nitrogen split on yield of potato	43
45	Sowing of potato in different dates to gain maximum potato yield under changing climate scenario.	44
46	Evaluation of potato varieties for organic farming.	45
47	Potato Research Station, Sahowali (Sialkot)	46
48	Effect of plant spacing on the yield of new strains, sh-1650, sh-1655, sh-1658 and sh-1662.	46
49	Survey of Black Scurf/Rhizoctonia and Common Scab Disease Incidence Of Potato	47
50	Drought tolerance study in potato strains of SH-1650, SH-1655, SH-1658 and SH-1662.	49
51	FOOD TECHNOLOGY	49
52	Potato Research Institute, Sahiwal	49
53	Screening of varieties /strains for high dry matter contents and specific gravity	49

INTRODUCTION

Potato is an important agricultural crop widely grown in different agro-climatic conditions of Pakistan and throughout the world. It is one of the four major staples which has a significant contribution to national domestic consumption and food needs. Potato is rich in starch and having the highest productivity per unit area, it has great potential to address the challenge of food security. In many European countries, potato serves as staple food. In Pakistan also, potato is the part and parcel of common man's daily diet. In Pakistan, potato is cultivated all around the country from mountains to shores. In Punjab, its cultivation is concentrated in the districts of Okara, Pakpattan, Sahiwal, and Kasur, called the "Potato core area".

In Pakistan, potato production has been increased 164 times from 28 thousand tons to 4591.8 thousand tons from 1947 to 2017-18. In Punjab, potato was grown on **180.6** thousand hectares with a production of **4402.6** thousand tones with an average yield of 24.4 t/ha during 2017-18. Although the average yield of potato in Pakistan is higher than the world average, however, it is far low as compared to the developed potato producing countries i.e New Zealand, Netherland, France, Germany etc. so this is the area to work at. Low productivity of the crop in Pakistan is due to several biotic, abiotic stresses, and the relatively limited allocation of land. Different biotic constraints, including pathogenic diseases such as late blight, early blight, bacterial wilt and viral infections have a tremendous impact on potato production. Temperature extremes, nutrient deficit soil, poor irrigation water, lack of availability of quality seed potatoes are among the abiotic stresses which pose challenges to potato productivity. Moreover, the allocation of the significantly lower area for the harvest to potato cultivation than other crops is also among the important underlying issues which result in substantial low yields of potato in Pakistan. PRI, Sahiwal conducted different experiments to manage the challenges associated with yield and production and crop losses of potato in the country.

Genetic diversity in potato cultivars has also been studied for yield & disease resistance in locally adapted potato cultivars. The Research on Potato is concentrated at Potato Research Institute, Sahiwal, Potato Research Station, Sahowali (Sialkot), and Potato Breeding Research Sub-Station, Murree with the following SMART (specific, measurable, achievable, realistic & time-bound) objectives:

- Development of high yielding, disease resistant, frost tolerant and good quality potato varieties through conventional breeding
- Standardization of production technology for elite potato strains
- Pathological studies to control fungal, viral and other diseases

- Quality evaluation to feed the Potato Processing Industry
- Pre-basic and basic seed production through modern techniques of tissue culture

Multifarious research experiments on all above mentioned important aspects of Potato crop were properly planned and carried out at Potato Research Institute, Sahiwal and its sub formations i.e., Potato Research Station, Sahowali (Sialkot) and Potato Research Sub-Station, Murree.

Table No. 1. TECHNICAL STAFF POSITION

Name of the Post	Total sanctioned strength	Filled	Vacant
Potato Research Institute, Sahiwal			
Director	1	1	-
Botanist	1	-	1
Assistant Botanist Potato	1	1	-
Assistant Food Technologist	1	-	1
Assistant Research Officer (PBG)	5	2	3
Assistant Research Officer (PP)	1	-	1
Assistant Research Officer (FT)	1	-	1
Total	11	4	7
Potato Research Station (Sialkot)			
Potato Botanist	1	-	1
Assistant Botanist Potato	1	-	1
Assistant Plant Pathologist	1	1	-
Assistant Research Officer (PBG)	1	-	1
Total	4	1	3
Potato Research Sub-station, Faisalabad			
Assistant Research Officer (FT)	1	-	1
Total	1		1
Potato Research Sub Station (Muree)			
Assistant Research Officer (PBG)	1	1	-
Total	1	1	-
Grand Total	17	06	11

1. PLANT BREEDING:

A. Potato Research Institute Sahiwal:

1. Maintenance of Germplasm:

260 strains/varieties were maintained at Potato Research Institute, Sahiwal. The material was sown on **28.10.2019** keeping plant to plant and row to row distances as 20 cm and 75 cm, respectively with the plot size 6 m x 0.75 m. The trial was conducted non replicated single row layout. Standardized agronomic and plant protection measures were carried out during the entire cropping season. The material was maintained and diseased & off type plants were uprooted. The strains / varieties having favorable characteristics will be used in further breeding programme for the development of high yielding potato varieties tolerant to biotic and abiotic stresses.

2.1. Evaluation of Potato Strains/Varieties against Frost Incidence at PRI, Sahiwal.

This study was planned to evaluate 8 elite strains/varieties against frost incidence at Potato Research Institute, Sahiwal. The trial was planted on **23.10.2019**, keeping 20cm plant to plant and 75cm row to row spacing. The plot size was maintained as 6.0 m x 1.5 m. The trial was laid out according to the RCB design with three replications. Standard agronomic practices were conducted and appropriate plant protection measures were adopted. Mild frost incidence was observed during the month of January crop growth period. The harvesting was done on **20.02.2020**. Data regarding emergence %age, tuber grades, yield and frost tolerance were recorded.

Table No. 2: Performance of strains/varieties against frost at PRI, Sahiwal

Rank	Variety	Emer. (%)	Tuber Grade (%)			Yield (t/ha)	Frost (Score)
			<35 mm	35-55mm	>55 mm		
1	FD 74-38	96.1	23.0	52.3	24.7	38.2	8.0
2	FD 76-59	96.1	16.3	49.4	34.3	41.1	8.0
3	FD 81-1	97.2	21.7	43.0	35.3	37.2	8.0
4	Sadaf	100.0	34.7	41.6	23.7	36.5	8.0
5	Ruby	100.0	21.3	50.7	28.0	37.3	7.0
6	FD 74-28	98.9	23.3	59.4	17.3	32.5	7.0
7	SL 5-2	97.2	22.7	48.6	28.7	31.6	7.0
8	SL 10-4	56.1	18.3	42.0	39.7	20.4	6.0
LSD 5%		7.30	10.04	11.83	6.51	5.15	N.S

Table No. 3: Frost score Table

Rating No.	Amount of foliage/tuber injury
0	Plant dead to seed piece and some tubers or seed piece frozen.
1	Plant dead to soil line, tuber un-injured, plant regenerate from seed piece.
2	90% of leaves severely injured, lower stem alive and regenerate axillary's buds, no tuber injury.
3	60% of leaves severely injured, upper 1/3 of skin froze. Axillary buds develop.
4	25% of leaves severely injured, stem tip frozen, axillary buds develop.
5	10% of leaves severely injured, stem tip injured, axillary buds develop.
6	10% of leaves damaged, stem tip water soaked in spot, axillary buds develop.
7	10% of leaves slightly damaged, stem tip injured, plants continue to grow.
8	10% of leaves frozen without necrotic spots on leaf tip and edge.
9	No injury.

During the crop growth period, mild frost incidence was observed. However, the local strains / varieties FD 74-38, FD 76-59, FD 81-1 & Sadaf (Check) showed maximum tolerance (score 8 of each) followed by the variety / strains Ruby, FD 74-28 & SL 5-2 (Score 7.0 of each). The strain FD 76-59 produced the maximum yield (41.1 t/ha) followed by FD 74-38 (38.2 t/ha). Lowest yield was produced by the strain SL 10-4 (20.4 t/ha).

2.2. Evaluation of Potato Strains/Varieties against Frost Incidence at BARI, Chakwal.

Frost is a severe threat to potato crop during the autumn season. Researchers are trying to select frost tolerant varieties to overcome this issue. The study was carried out to test the performance of **eight** elite strains/varieties against frost at Barani Agricultural Research Institute, Chakwal. The sowing was done on **24.10.2019**, keeping plant to plant and row to row distances as 20 & 75 cm, respectively. The plot size was maintained as 6 m x 0.75 m. The trial was laid out according to the RCB design with two replications. Appropriate agronomic and plant protection measures were carried out in the crop. During the crop growth period, severe frost incidence was observed. The harvesting was done on **25.02.2020**. Data regarding emergence %age, tuber grades, tuber yield and frost tolerance were recorded.

Table No. 4: Performance of strains/varieties against frost at BARI, Chakwal

Rank	Variety	Tuber Grade (%)			Yield (t/ha)	Frost tolerance (Score)
		<35 mm	35-55 mm	>55 mm		
1	FD 74-38	81.5	18.5	0.0	4.7	4.0
2	FD 76-59	86.0	14.0	0.0	2.2	4.0
3	FD 81-1	76.5	23.5	0.0	5.0	4.0
4	FD 74-28	78.5	21.5	0.0	4.2	4.0
5	Ruby	89.0	11.0	0.0	2.0	3.0
6	Sadaf	78.5	21.5	0.0	5.3	3.0
7	SL 5-2	87.0	13.0	0.0	2.0	3.0
8	SL 10-4	83.5	16.5	0.0	1.1	2.0
LSD 5%		14.56	14.56	N.S	1.32	N.S

During the month of January, severe spells of frost were observed and the strains/varieties included in the experiment showed a different degree of tolerance against frost. It was observed that the strains FD 74-38, FD 76-59, FD 81-1 & FD 74-28 showed maximum tolerance (score **4.0** each) against frost followed by Ruby, Sadaf & SL 5-2 (score **3.0** each) whereas the strain SL 10-4 ranked at last position, showed low tolerance (score **2.0**) against frost. Regarding yield point of view, the maximum yield was produced by the variety Sadaf (5.3 t/ha) followed by FD 74-38 which yielded 4.7 t/ha. The lowest yield (1.1 t/ha) was produced by the strain SL 10-4.

3.1. Zonal varietal yield trial at PRI, Sahiwal

06 advance potato lines were evaluated against two standard entries i.e. “Ruby” and “Sadaf” at Potato Research Institute, Sahiwal. The material was sown on **23.10.2019**, keeping 20 cm plant to plant and 75 cm row to row distances. The plot size was kept 6.0 m x 1.5 m. The trial was laid out according to the Randomized Complete Block Design with three replications. Standardized agronomic and plant protection practices were adopted. Harvesting was done on **20.03.2020**. Data regarding emergence %age, tuber grades, disease infestation, and yield were recorded which are presented below:

Table No. 5: Performance of strains/varieties in Zonal Varietal Yield trial at PRI, Sahiwal

Rank	Variety	Emer. (%)	Tuber Grade (%)			Tuber Diseases (%)			Yield (t/ha)
			<35 mm	35-55mm	>55 mm	Scab (Score)	Rhiz.	Crack	
1	FD 76-59	96.1	15.0	43.0	42.0	1.0	0	0.7	44.8
2	Sadaf	100.0	29.7	56.0	14.3	1.0	0	0.0	42.5
3	FD 81-1	96.1	22.7	52.0	25.3	1.0	0	0.0	39.1
4	FD 74-38	98.3	16.7	63.6	19.7	1.0	0	1.0	38.7
5	SL 5-2	98.9	23.7	53.3	23.0	1.0	0	0.7	35.7
6	FD 74-28	100.0	26.0	54.0	20.0	1.0	0	0.0	35.5
7	Ruby	99.4	25.0	59.0	16.0	1.0	0	14.3	34.8
8	SL 10-4	86.1	16.0	46.0	38.0	1.0	0	1.3	31.6
LSD 5%		4.55	5.84	11.22	11.29	N.S	0.00	1.46	3.95

In these studies, six advance potato lines were evaluated with respect to yield against two standard varieties Ruby & Sadaf. It is evident from results of the trials conducted at Potato Research Institute, Sahiwal that FD 76-59 proved its worth in this respect is at the top with 44.8 t/ha tuber yield followed by commercial variety Sadaf with 42.5 t/ha tuber yield. The lowest tuber yield was produced by the strain SL 10-4 (31.6 t/ha). The maximum emergence (100.0%) was recorded in the variety Sadaf & the strain FD 74-28 each whereas the minimum by the strain SL 10-4 (86.1%). Regarding Tuber grades, it was noted that the strain FD 76-59 produced maximum ratio size tubers (**42.6%**). Maximum percentage of small size tubers (29.7%) was

produced by the commercial variety Sadaf. Regarding scab infestation and Rhizoctonia incidence, it was observed that all the entries showed tolerance against scab and Rhizoctonia. Maximum cracks (**14.3%**) were observed in the local check variety “Ruby”.

3.2. Zonal varietal yield trial at BARI, Chakwal

06 advance potato lines were evaluated against two standard entries i.e. “Ruby” and “Sadaf” at Barani Agricultural Research Institute, Chakwal. The material was sown on **24.10.2019**, keeping 20 cm plant to plant and 75 cm row to row distances. The plot size was kept 6.0 m x 1.5 m. The trial was laid out according to the Randomized Complete Block Design with two replications. Standardized agronomic and plant protection practices were adopted. Harvesting was done on **25.02.2020**. Data regarding tuber grades, disease infestation, and yield were recorded which are presented below:

Table No. 6: Performance of strains/varieties in Zonal Varietal Yield trial at BARI, Chakwal

Rank	Variety	Tuber Grade (%)			Tuber Diseases (%)			Yield (t/ha)
		<35 mm	35-55mm	>55 mm	Scab (score)	Rhiz.	Crack	
1	Sadaf	64.0	36.0	0.0	1.0	0.0	0.0	11.0
2	FD 74-28	63.0	34.5	2.5	1.0	27.5	0.0	9.6
3	FD 76-59	48.5	48.0	3.5	1.0	0.0	0.0	8.9
4	FD 81-1	71.0	27.5	1.5	1.0	0.0	0.0	8.4
5	FD 74-38	89.0	11.0	0.0	1.0	0.0	0.0	5.4
6	Ruby	83.0	17.0	0.0	1.5	11.0	0.0	5.2
7	SL 5-2	82.5	17.5	0.0	1.0	0.0	0.0	4.8
8	SL 10-4	85.0	15.0	0.0	1.0	11.0	0.0	4.7
LSD 5%		22.94	21.04	3.21	N.S	3.94	0.00	4.66

In these studies, six advance potato lines were evaluated with respect to yield against two standard varieties Ruby & Sadaf. It is evident from results of the trials conducted at Barani Agricultural Research Institute, Chakwal that the commercial variety Sadaf proved its worth in this respect is at the top with 11.0 t/ha tuber yield followed by FD 74-28 with 9.6 t/ha tuber yield. The lowest tuber yield was produced by the strain SL 10-4 (4.7 t/ha). Regarding Tuber grades, it was noted that the strain FD 76-59 produced maximum ration size tubers (**3.5%**). Minimum percentage of medium size tubers (48.0%) was produced by the Strain FD 76-59. Regarding, tuber diseases, all the entries showed same scab score (1.0). Maximum Rhizoctonia incidence (27.5%) was observed in the strain FD 74-28. All the entries showed tolerance against tuber cracking.

3.3. Zonal varietal yield trial at CRI, Multan

06 advance potato lines were evaluated against two standard entries i.e. “Ruby” and “Sadaf” at Cotton Research Institute, Multan. The material was sown on **19.11.2019**, keeping

20 cm plant to plant and 75 cm row to row distances. The plot size was kept 5.0 m x 1.5 m. The trial was laid out according to the Randomized Complete Block Design with three replications. Standardized agronomic and plant protection practices were adopted. Harvesting was done on **31.03.2020**. Data regarding emergence %age, tuber grades, disease infestation, and yield were recorded which are presented below:

Table No. 7: Performance of strains/varieties in Zonal Varietal Yield trial at CRI, Multan

Rank	Variety	Emer. (%)	Tuber Grade (%)			Tuber Diseases (%)			Yield (t/ha)
			<35 mm	35-55mm	>55 mm	Scab	Rhiz.	Crack	
1	FD 81-1	86.7	14.7	72.0	13.3	1.0	0.0	0	19.1
2	FD 76-59	81.3	22.7	71.3	6.0	1.0	0.0	0	18.4
3	FD 74-38	88.0	12.3	77.4	10.3	1.0	0.0	0	18.2
4	Ruby	94.0	17.0	74.7	8.3	1.0	2.7	0	18.0
5	FD 74-28	69.3	16.0	76.3	7.7	1.0	0.0	0	17.3
6	Sadaf	92.0	22.0	70.0	8.0	1.0	0.0	0	16.0
7	SL 5-2	82.0	16.0	73.7	10.3	1.0	0.0	0	15.1
8	SL 10-4	22.7	14.7	72.0	13.3	1.0	1.3	0	6.7
LSD 5%		10.44	3.14	2.35	1.87	1.76	0.75	0.00	2.12

In these studies, six advance potato lines were evaluated with respect to yield against two standard varieties Ruby & Sadaf. It is evident from results of the trials conducted at Cotton Research Institute, Multan that FD 81-1 proved its worth in this respect is at the top with 19.1 t/ha tuber yield followed by FD 76-59 with 18.4 t/ha tuber yield. The lowest tuber yield was produced by the strain SL 10-4 (6.7 t/ha). The maximum emergence (94.0%) was recorded in the variety “Ruby” whereas the minimum by the strain SL 10-4 (22.7%). Regarding Tuber grades, it was noted that the strains FD 81-1 and SL 10-4 produced maximum ration size tubers (13.3% each). Maximum percentage of medium size tubers (77.4%) was produced by the Strain FD 74-38. Regarding, tuber diseases, all the entries showed same scab score (1.0). Maximum Rhizoctonia incidence (2.7%) was observed in the commercial variety Ruby. All the entries showed tolerance against tuber cracking.

3.3. Zonal varietal yield trial at PRS, Sahowali (Sialkot)

Eight lines/varieties were received from the Directorate of Potato Research Institute, Sahiwal. The trial was sown on 19.11.2019 with three replication keeping plot size of 6 x 2.25m for their evaluation under Sahowali, Sialkot conditions and was harvested 20.04.2020. Data on emergence percentage, tuber grades, tuber diseases and tuber yield were recorded and are presented below in table:

Table No. 8: Performance of strains/varieties in Zonal Varietal Yield trial at PRS, Sahowali (Sialkot)

Rank	Variety	Emer. (%)	Tuber Grade (%)			Tuber Diseases (%)			Yield (t/ha)
			<35 mm	35-55mm	>55 mm	Scab (Score)	Rhiz.	Crack	
1	FD 81-1	55.7	7.7	65.6	26.7	1.0	0.7	0.0	22.1
2	FD 74-38	56.2	9.3	63.7	27.0	1.0	0.0	0.0	19.6
3	SL 5-2	54.3	4.3	69.0	26.7	1.0	0.0	0.0	17.7
4	Sadaf	56.7	3.3	68.0	28.7	1.0	0.0	0.0	17.6
5	FD 74-28	51.7	3.7	67.0	29.3	1.0	0.0	0.0	16.4
6	FD 76-59	44.3	4.7	63.3	32.0	1.0	0.0	0.0	16.2
7	SL 10-4	48.3	6.0	68.3	25.7	1.0	1.7	0.0	15.3
8	Ruby	56.3	3.0	66.7	30.3	1.0	0.0	0.0	14.2
LSD 5%		7.15	3.12	5.35	6.21	1.94	0.98	N.S	3.07

From the above table it is cleared that the strain FD 81-1 showed the maximum yield potential of 22.1 tones per hectare followed by a yield of 19.6 tones per hectare of a line FD 74-38 whereas minimum yield was observed in commercial potato variety Ruby as 14.2 tones per hectare.

4. National Uniform Potato Yield Trial.

11 potato strains were tested against two check varieties at four locations i.e., Potato Research Institute Sahiwal, Potato Research Station, Sahowali, (Sialkot), National Agricultural Research Center, Islamabad and Cotton Research Institute, Multan. The data from NARC, Islamabad were not received yet. Out of eleven entries, only seven were tested at CRI, Multan location. The material was planted on **29.10.19**, **01.11.19** and **19.11.19** at PRI, Sahiwal, PRS, Sahowali (Sialkot) & CRI, Multan respectively with 20cm plant to plant and 75.cm row-to-row distances. The trial was laid out according to Randomized Complete Block design with three replications. Standardized agronomic and plant protection measures were carried out to raise the crop properly. Trials were harvested on **24.02.20**, **1.03.20** & **31.03.20** respectively. The data regarding emergence percentage, tuber grades, tuber diseases, and tuber yield were recorded.

Table No. 9: Emergence percentage of varieties/strains at different locations

Rank	Variety	PRI Sahiwal	PRS, SKT	NARC, Islamabad	CRI, Multan	Average
1	Sadaf	88.0			96.4	92.2
2	Ruby	86.0			96.0	91.0
3	FD-75-6	88.7			91.1	89.9
4	Rustam White	89.0			-	89.0
5	Potato-2	87.0			88.9	88.0

6	FD-76-55	84.6			91.1	87.9
7	Potato-3	86.0			89.3	87.7
8	Rustam Red	86.0			-	86.0
9	Rustam Early	85.7			-	85.7
10	SH-1655	83.0			-	83.0
11	SH-1658	78.7			-	78.7
12	SL-28-72	83.0			69.8	76.4
13	SH-1650	66.7			-	66.7
LSD 5%		5.48			6.21	

The data presented in Table 9 shows that on average basis, maximum emergence **92.2%** was shown by the local check variety Sadaf followed by the local check variety Ruby which showed **91.0%** emergence whereas the minimum emergence was recorded from the local strain SH-1650 (**66.7%**)

Table No. 10: Small size tuber (<35mm) of varieties/strains at different locations

Rank	Variety	PRI Sahiwal	PRS, SKT	NARC, Islamabad	CRI, Multan	Average
1	SL-28-72	14.0	28.7		11.7	18.1
2	Rustam Early	17.7	22.3		-	20.0
3	FD-75-6	21.0	28.7		15.0	21.6
4	Potato-3	26.7	34.0		6.3	22.3
5	Potato-2	23.7	35.0		10.3	23.0
6	SH-1658	18.7	33.0		-	25.9
7	SH-1655	11.0	41.3		-	26.2
8	Sadaf	22.7	46.7		11.0	26.8
9	Rustam White	21.7	32.7		-	27.2
10	Rustam Red	24.7	30.3		-	27.5
11	FD-76-55	22.3	31.3		31.7	28.4
12	Ruby	23.0	35.0		27.7	28.6
13	SH-1650	27.0	35.0		-	31.0
LSD 5%		5.30	4.78		3.11	

The data presented in Table 10 shows that on average basis, minimum small size tuber percentage **18.1%** was shown by the strain SL 28-72 followed by the strain Rustum Early which showed **20.0%** small size tuber percentage whereas the maximum small size tubers (**31.0%**) were recorded from the local strain SH-1650.

Table No. 11: Medium size tuber (35-55mm) of varieties/strains at different locations

Rank	Variety	PRI Sahiwal	PRS, SKT	NARC, Islamabad	CRI, Multan	Average
1	Potato-2	72.7	60.7		79.3	70.9
2	Potato-3	67.3	60.0		84.7	70.7
3	Rustam Early	70.0	67.3		-	68.7
4	Sadaf	68.3	53.3		81.7	67.8
5	SH-1658	70.7	64.7		-	67.7
6	Rustam Red	68.0	61.3		-	64.7
7	SH-1655	73.7	53.7		-	63.7
8	Ruby	65.7	58.4		62.0	62.0
9	SL-28-72	54.0	54.3		77.0	61.8
10	Rustam White	68.7	54.3		-	61.5
11	SH-1650	64.0	54.0		-	59.0
12	FD-76-55	62.7	55.0		56.0	57.9
13	FD-75-6	52.0	51.0		64.7	55.9
	LSD 5%	8.40	3.92		2.11	

The data presented in Table 11 shows that on average basis, maximum medium size tuber percentage **70.9%** was shown by the strain Potato-2 followed by the strain Potato-3 which showed **70.7%** medium size tuber percentage whereas the minimum medium size tubers (**55.9%**) were recorded from the local strain FD 75-6.

Table No. 12: Large size tuber (>55mm) of varieties/strains at different locations

Rank	Variety	PRI Sahiwal	PRS, SKT	NARC, Islamabad	CRI, Multan	Average
1	FD-75-6	27.7	20.3		20.3	22.8
2	SL-28-72	24.7	17.0		11.3	17.7
3	FD-76-55	15.0	13.7		12.3	13.7
4	Rustam White	9.7	13.0		-	11.4
5	Rustam Early	12.3	10.3		-	11.3
6	SH-1650	8.3	11.0		-	9.7
7	SH-1655	15.0	4.0		-	9.5
8	Ruby	11.0	6.6		10.3	9.3
9	Rustam Red	7.3	8.3		-	7.8
10	Potato-3	6.0	6.0		9.0	7.0
11	SH-1658	10.7	2.3		-	6.5

12	Potato-2	3.7	4.3		10.3	6.1
13	Sadaf	9.0	0.0		8.0	5.7
LSD 5%		4.86	3.67		3.25	

The data presented in Table 12 shows that on average basis, maximum ration size tuber percentage **22.8%** was shown by the strain FD 75-6 followed by the strain SL 28-72 which showed **17.7%** ration size tuber percentage whereas the minimum ration size tubers (**5.7%**) were recorded from the local check variety Sadaf.

Table No. 13: Scab %age of varieties/strains at different locations

Rank	Variety	PRI Sahiwal	PRS, SKT	NARC, Islamabad	CRI, Multan	Average
1	Rustam Early	1.3	3.7		-	2.5
2	Potato-3	5.3	4.7		0.0	3.3
3	Sadaf	9.7	5.3		0.0	5.0
4	Potato-2	11.7	2.7		1.3	5.2
5	SH-1658	8.7	2.3		-	5.5
6	Rustam Red	10.0	1.7		-	5.9
7	Rustam White	11.0	2.3		-	6.7
8	SH-1655	15.0	1.7		-	8.4
9	FD-75-6	12.3	5.0		8.3	8.5
10	SL-28-72	20.7	4.0		7.0	10.6
11	Ruby	25.3	2.3		5.3	11.0
12	FD-76-55	22.0	6.7		5.0	11.2
13	SH-1650	33.0	3.0		-	18.0
LSD 5%		9.92	2.53		1.13	

The data presented in Table 13 shows that on average basis, minimum scab incidence **2.5%** was shown by the strain Rustum Early followed by the strain Potato-3 which showed **3.3%** scab incidence whereas the maximum scab incidence (**18.0%**) was recorded from the local strain SH-1650.

Table No. 14: Rhizoctonia %age of varieties/strains at different locations

Rank	Variety	PRI Sahiwal	PRS, SKT	NARC, Islamabad	CRI, Multan	Average
1	FD-75-6	0.0	0.3		0.0	0.1
2	FD-76-55	0.0	0.7		0.0	0.2
3	Ruby	0.0	0.7		0.0	0.2
4	Sadaf	0.0	0.7		0.0	0.2

5	Rustam White	0.0	0.3		-	0.2
6	SL-28-72	0.0	1.0		0.0	0.3
7	Potato-3	0.0	1.3		0.0	0.4
8	SH-1658	0.0	1.0		-	0.5
9	Rustam Early	0.0	1.0		-	0.5
10	Rustam Red	0.0	1.0		-	0.5
11	Potato-2	0.0	1.7		0.0	0.6
12	SH-1650	0.0	1.3		-	0.7
13	SH-1655	0.0	2.7		-	1.4
LSD 5%		N.S	0.97		N.S	

The data presented in Table 14 shows that on average basis, minimum Rhizoctonia incidence **0.1%** was shown by the strain FD 75-6 followed by the strain FD 76-55 which showed **0.2%** Rhizoctonia incidence whereas the maximum Rhizoctonia incidence (**1.4%**) was recorded from the local strain SH-1655.

Table No. 15: Cracking %age of varieties/strains at different locations

Rank	Variety	PRI Sahiwal	PRS, SKT	NARC, Islamabad	CRI, Multan	Average
1	FD-76-55	0.0	0.0		0.0	0.0
2	SL-28-72	0.0	0.0		0.0	0.0
3	Sadaf	0.0	0.0		0.0	0.0
4	SH-1655	0.0	0.0		-	0.0
5	SH-1658	0.0	0.0		-	0.0
6	Potato-3	0.3	0.0		0.0	0.1
7	SH-1650	0.3	0.0		-	0.2
8	Rustam White	0.3	0.0		-	0.2
9	Rustam Early	1.3	0.0		-	0.7
10	Potato-2	0.0	0.0		2.0	0.7
11	Rustam Red	3.3	0.0		-	1.7
12	FD-75-6	4.3	0.0		3.3	2.5
13	Ruby	25	0.0		0.0	8.3
LSD 5%		9.92	N.S		1.69	

The data presented in Table 15 shows that on average basis, five entries i.e. FD 76-55, SL 28-72, Sadaf, SH-1655 & SH-1658 showed resistance against tuber cracking (**0.0%**) whereas the maximum tuber cracking (**8.3%**) was recorded from the local check variety Ruby.

Table No. 16: Tuber yield (t/ha) of varieties/strains at different locations

Rank	Variety	PRI Sahiwal	PRS, SKT	NARC, Islamabad	CRI, Multan	Average
1	Rustam White	34.2	31.9		-	33.1
2	FD-75-6	41.2	30.9		16.0	29.4
3	Rustam Red	29.8	28.6		-	29.2
4	Rustam Early	26.8	31.2		-	29.0
5	Potato-3	31.8	25.6		26.5	28.0
6	FD-76-55	32.9	29.9		19.3	27.4
7	Sadaf	36.5	23.2		21.9	27.2
8	Potato-2	26.6	23.8		21.5	24.0
9	SL-28-72	33.6	17.4		18.2	23.1
10	Ruby	29.3	18.2		17.6	21.7
11	SH-1658	18.8	23.2		-	21.0
12	SH-1650	21.8	15.2		-	18.5
13	SH-1655	21.3	14.3		-	17.8
LSD 5%		5.27	3.41		1.68	

The data presented above shows that on an average basis, the maximum tuber yield (**33.1 t/ha**) was recorded in the strain Rustum White followed by FD 75-6 with **29.4 t/ha**, tuber yield whereas the minimum tuber yield (**17.8 t/ha**) was produced by the strain SH-1655. Overall, maximum tuber yield was observed at PRI, Sahiwal location whereas minimum at CRI, Multan location. However, the highest recorded tuber yield was 41.2 t/ha exhibited by the strain FD 75-6 at Sahiwal location. six experimental strains / entries viz: Rustum White, FD 75-6, Rustum Red, Rustum Early, Potato-3 & FD 76-55 surpassed the standard varieties Sadaf (**27.2 t/ha**) & Ruby (**21.7 t/ha**).

5. National Uniform Potato Yield Trial for dry matter at PRI, Sahiwal.

A total of 6 potato varieties / lines including one commercial check variety i.e. Lady Rosetta were evaluated in National Uniform Potato Yield Trial for their yield and dry matter contents at Potato Research Institute, Sahiwal. The material was sown on **25.10.2019**, keeping 20 cm plant to plant and 75 cm row to row distances. The plot size was kept 6.0 m x 2.25 m. The trial was laid out according to the Randomized Complete Block Design with three replications. Standardized agronomic and plant protection practices were adopted. Harvesting was done on **21.02.2020**. Data regarding emergence, tuber grades, disease infestation, yield, dry matter contents and specific gravity were recorded which are presented below:

Table No. 17: Performance of strains / varieties in NUYT trial for dry matter at PRI, Sahiwal

Rank	Variety	Emer. (%)	Tuber Grade (%)			Tuber Diseases (%)			Yield (t/ha)	Dry Matter (%)	Dry matter (t/ha)
			<35 mm	35-55 mm	>55 mm	Scab (Score)	Rhiz.	Crack			
1	FD-35-36	86.0	28.0	59.0	13.0	1.0	0.0	1.7	36.4	19.6	7.1
2	Lady Rosetta	86.0	23.0	71.0	6.0	1.0	0.0	2.3	31.5	22.2	7.0
3	SL-5-2	66.7	17.0	65.3	17.7	1.0	0.0	2.0	35.3	19.0	6.7
4	FD-74-30	86.0	23.0	68.0	9.0	1.0	0.0	0.0	28.9	23.3	6.7
5	N-9625	86.0	23.0	70.0	7.0	1.0	0.0	0.3	29.4	22.3	6.6
6	FD-74-28	80.7	21.0	58.0	21.0	1.0	0.0	0.3	32.9	18.7	6.2
LSD 5%		13.4	9.2	5.07	6.27	13.6	N.S.	1.03	8.6	1.3	

It is shown by the results presented above that the highest tuber yield (36.4 t/ha) was recorded in the strain FD 35-36 followed by the strain SL 5-2 which produced 35.3 t/ha. The lowest tuber yield (28.9 t/ha) was recorded in the FD 74-30. Highest dry matter contents (**23.3%**) were recorded in the local strain FD 74-30 followed by the local strain N-9625 which produced **22.3%** dry matter contents. The Commercial check variety produced 22.2% dry matter contents. The lowest dry matter contents (**18.7%**) were recorded from the variety FD 74-28. The strain FD 35-36 produced highest dry matter (**7.1 tons**) on per hectare basis followed by the check variety Lady Rosetta which produced **7.0 tons** dry matter per hectare whereas the strain “FD 74-50” produced lowest dry matter (**6.2 tons**). The lowest emergence was recorded in the strain SL 5-2 (**66.7%**). Regarding Tuber grades, it was noted that “FD 74-28” produced maximum ration size tubers (**21.0%**). Maximum medium size tuber (**71.0%**) were noted in the commercial check variety Lady Rosetta. Regarding, tuber diseases, all the entries showed same scab score (1.0). All the entries showed tolerance against Rhizoctonia whereas maximum tuber cracking (**2.3%**) was observed in commercial check variety Lady Rosetta.

6. ADAPTABILITY TRIALS OF EXOTIC POTATO VARIETIES IMPORTED BY DIFFERENT SEED COMPANIES DURING 2019-20

18 exotic varieties imported by five different seed companies were tested along with standard varieties / local checks in adaptability trials at Potato Research Institute (PRI) Sahiwal. Out of these, Four exotic potato varieties were also tested at Potato Research Station, Sahowali (Sialkot) and Cotton Research Institute, Multan. Seed potatoes of these varieties were received at PRI, Sahiwal during autumn crop season at different dates. These varieties were planted in three sets at PRI, Sahiwal, one set each at CRI, Multan & PRS Sahowali (Sialkot) in Randomized Complete Block Design with three replications and 6.0m x 2.25m plot size keeping plant to plant and row to row distances of 20 cm and 75 cm, respectively. The planting and harvesting were done on the dates mentioned in the respective tables. Standard agronomic and plant protection practices were followed to raise the crop. The results obtained and the data

recorded on these potato varieties are given below. Data regarding emergence, tuber grades, tuber diseases and yield were recorded. The results are presented in Tables below:

Table No. 18: Performance of potato strains/varieties in an Adaptability Trial at Potato Research Institute, Sahiwal (Set-I)

Rank	Variety	Company Name	Emer (%)	Tuber Grade (%)			Tuber Diseases (%)			Yield (t/ha)
				<35 mm	35-55 mm	>55 mm	Scab (Score)	Rhiz	Crack	
1	Balaton Rozsa	Jaffer Agro Services	78.3	10.0	40.0	50.0	1.5	0.0	3.0	33.8
2	Sadaf	Commercial Check	90.0	20.3	57.7	22.0	1.0	0.0	0.0	29.2
3	Ferrari	Jaffer Agro Services	86.0	14.7	70.3	15.0	1.0	0.0	2.0	28.2
4	Aurea	Jaffer Agro Services	82.0	13.0	63.0	24.0	1.5	0.0	8.3	27.5
5	Elbeida	Jaffer Agro Services	86.6	23.7	55.0	21.3	1.0	0.0	0.3	25.8
6	Ruby	Commercial Check	87.3	18.0	60.3	21.7	1.0	0.0	11.0	24.9
7	White Lady	Jaffer Agro Services	86.0	14.7	67.3	18.0	1.5	0.0	1.7	24.8
8	Surya	Jaffer Agro Services	73.6	21.7	49.6	28.7	1.0	0.0	1.0	24.3
9	Crisper	Jaffer Agro Services	85.0	26.3	57.4	16.3	1.5	0.0	9.3	23.1
10	Eldorado	Jaffer Agro Services	87.0	29.3	63.7	7.0	1.0	0.0	4.7	19.7
11	Frivol	Jaffer Agro Services	80.3	22.3	70.7	7.0	1.0	0.0	6.3	19.1
12	Oclair	Jaffer Agro Services	80.3	31.3	64.4	4.3	1.0	0.0	0.0	17.8
13	Basa	Jaffer Agro Services	70.3	18.0	70.7	11.3	1.0	0.0	0.0	15.0
LSD 5%			11.2	5.9	7.2	5.9	N.S	N.S	4.1	3.8
			<i>Date of Planting = 16.10.2019</i>							
			<i>Date of Harvesting = 10.02.2020</i>							

It is revealed from the above Table that the exotic variety Balaton Rozsa gave the maximum yield (**33.8 t/ha**) followed by the local variety Sadaf which yielded **29.2 t/ha**. The lowest yield was produced by the exotic variety Basa (**15.0 t/ha**). Regarding emergence percentage, it was noticed that the highest emergence (**90.0%**) was shown by the local variety Sadaf whereas the lowest emergence was shown by the exotic variety Basa (70.3 %). Tuber grades are important from the commercial view point. In this respect, it was observed that the exotic variety Baltoni Rozsa produced maximum ration size tubers i.e. **50.0%**. Maximum percentage (**31.3%**) of small size tubers was recorded from the exotic variety Oclair. Maximum percentage (**70.7%**) of medium size tubers was recorded from the exotic varieties Frivol & Basa

each. Regarding disease infection, it was observed that maximum scab infestation score (**1.5**) was recorded in exotic varieties Balatoni Rozsa, Aurea, White Lady & Crisper each. No Rhizoctonia incidence was observed on all tested entries. Maximum tuber cracking (**11.0%**) was recorded in commercial check variety Ruby.

Table No. 19: Performance of potato strains/varieties in an Adaptability Trial at Potato Research Institute, Sahiwal (Set-II)

Rank	Variety	Company Name	Emer. (%)	Tuber Grade (%)			Tuber Diseases (%)			Yield (t/ha)
				<35 mm	35-55 mm	>55 mm	Scab (Score)	Rhiz	Crack	
1	Sadaf	Commercial Check	89.0	18.3	74.0	7.7	1.0	0.0	0.0	34.6
2	Zorba	Seethi Seeds	87.3	19.7	71.0	9.3	1.0	0.0	1.7	30.8
3	Efera	Seethi Seeds	89.3	22.7	67.3	10.0	1.0	0.0	1.0	26.9
4	Ruby	Commercial Check	89.3	21.7	71.6	6.7	1.0	0.0	8.0	25.8
5	Red Bullet	Syko International	89.7	27.3	68.4	4.3	1.0	0.0	0.3	22.2
6	HZD-09-9446	Bari Traders	13.3	30.0	55.3	14.7	1.0	0.0	0.3	3.4
LSD 5%			2.37	8.21	10.82	4.57	N.S	N.S	2.22	3.30
				<i>Date of Planting = 04.11.2019</i>						
				<i>Date of Harvesting = 02.03.2020</i>						

It is revealed from the above Table that the local commercial check variety Sadaf gave the maximum yield (**34.6 t/ha**) followed by exotic variety Zorba which yielded **30.8 t/ha**. The lowest yield was produced by the exotic variety HZD-09-9446 (**3.4 t/ha**). Regarding emergence percentage, it was noticed that the highest emergence (**89.7%**) was shown by the exotic variety Red Bullet whereas the lowest emergence was shown by the exotic variety “HZD-09-9446” (13.3 %). Tuber grades are important from the commercial view point. In this respect, it was observed that the exotic variety Efera produced maximum ration size tubers i.e. **10.0%**. Maximum percentage (**30.0%**) of small size tubers was recorded from the exotic variety HZD-09-9446. Maximum percentage (**74.0%**) of medium size tubers was recorded from the commercial check variety Sadaf. Regarding disease infection, it was observed that all the varieties showed equal scab infestation score (**score 1**) and showed better performance against scab. All the varieties showed complete tolerance against Rhizoctonia. Maximum tuber cracking (**8.0%**) was recorded in commercial check variety Ruby whereas no cracking was observed in commercial check variety Sadaf.

Table No. 20: Performance of potato strains/varieties in an Adaptability Trial at Potato Research Institute, Sahiwal (Set-III)

Rank	Variety	Company Name	Emer. (%)	Tuber Grade (%)			Tuber Diseases (%)			Yield (t/ha)
				<35 mm	35-55 mm	>55 mm	Scab (Score)	Rhiz.	Crack	
1	Sadaf	Commercial Check	88.7	17.3	72.0	10.7	1.0	0.0	0.0	36.4
2	Sound	Bhatti Brothers	75.0	18.7	54.3	27.0	1.0	0.0	0.0	32.8
3	Ruby	Commercial Check	89.0	19.3	66.7	14.0	1.0	0.0	1.3	30.5
4	Lady Jane	Bhatti Brothers	78.0	19.7	74.6	5.7	1.0	0.0	0.0	29.5
5	Lady Alicia	Bhatti Brothers	88.3	29.3	65.7	5.0	1.0	0.0	0.0	9.4
LSD 5%			6.28	8.57	4.07	5.62	N.S	N.S	0.49	6.61
			<i>Date of Planting = 08.11.2019</i>							
			<i>Date of Harvesting = 17.03.2020</i>							

It is revealed from the above Table that the local commercial check variety Sadaf gave the maximum yield (**36.4 t/ha**) followed by exotic variety Sound which yielded **32.8 t/ha**. The lowest yield was produced by the exotic variety Lady Alicia (**9.4 t/ha**). Regarding emergence percentage, it was noticed that the highest emergence (**89.0%**) was shown by the commercial check variety Ruby whereas the lowest emergence was shown by the exotic variety “Sound” (75.0 %). Tuber grades are important from the commercial view point. In this respect, it was observed that the exotic variety Sound produced maximum ration size tubers i.e. **27.0%**. Maximum percentage (**29.3%**) of small size tubers was recorded from the exotic variety Lady Alicia. Maximum percentage (**74.6%**) of medium size tubers was recorded from the exotic variety Lady Jane. Regarding disease infection, it was observed that all the varieties showed equal scab infestation score (**score 1**) and showed better performance against scab. All the varieties showed complete tolerance against Rhizoctonia. Maximum tuber cracking (**1.3%**) was recorded in commercial check variety Ruby whereas no cracking was observed in all other varieties.

Table No. 21: Performance of potato strains/varieties in an Adaptability Trial at Cotton Research Institute, Multan (Set-I)

Rank	Variety	Company Name	Emer. (%)	Tuber Grade (%)			Tuber Diseases (%)			Yield (t/ha)
				<35 mm	35-55 mm	>55 mm	Scab (Score)	Rhiz.	Crack	
1	Sound	Bhatti Brothers	93.8	21.3	62.4	16.3	1.0	0.0	0.0	24.0
2	Sadaf	Commercial Check	90.5	23.3	66.0	10.7	1.0	0.0	0.0	23.4

3	Ruby	Commercial Check	88.7	25.3	65.4	9.3	1.0	0.0	0.0	21.5
4	Red Bullet	Syko International	92.0	37.7	55.6	6.7	1.0	0.0	0.0	18.4
5	Lady Jane	Bhatti Brothers	91.3	35.3	63.0	1.7	1.0	0.0	0.0	17.3
6	Lady Alicia	Bhatti Brothers	94.8	45.7	45.6	8.7	1.0	0.0	0.0	9.5
LSD 5%			11.71	2.40	2.13	2.37	N.S	N.S	N.S	4.35
<i>Date of Planting</i> = 29.11.2019 <i>Date of Harvesting</i> = 31.03.2020										

It is revealed from the above Table that the exotic variety Sound gave the maximum yield (**24.0** t/ha) followed by the local check variety Sadaf which yielded **23.4** t/ha. The lowest yield was produced by the exotic variety Lady Alicia (**9.5** t/ha). Regarding emergence percentage, it was noticed that the highest emergence (**94.8%**) was shown by the exotic variety Lady Alicia whereas the lowest emergence was shown by the local commercial check variety “Ruby” (**88.7** %). Tuber grades are important from the commercial view point. In this respect, it was observed that the exotic variety Sound produced maximum ration size tubers i.e. **16.3%**. Maximum percentage (**45.7%**) of small size tubers was recorded from the exotic variety Lady Alicia. Maximum percentage (**66.0%**) of medium size tubers was recorded from the commercial variety Sadaf. Regarding disease infection, it was observed that all the varieties showed tolerance against tuber defects (Scab, Rhizoctonia & Cracking).

Table No. 22: Performance of potato strains/varieties in an Adaptability Trial at Potato Research Station, Sahowali (Sialkot)

Rank	Variety	Company Name	Emer. (%)	Tuber Grade (%)			Tuber Diseases (%)			Yield (t/ha)
				<35 mm	35-55 mm	>55 mm	Scab (Score)	Rhiz.	Crack	
1	Sound	Bhatti Brothers	100.0	17.3	54.7	28.0	1.0	0.0	0.0	23.6
2	Ruby	Commercial check	98.0	32.3	62.0	5.7	1.0	0.0	0.0	22.5
3	Sadaf	Commercial check	95.7	80.3	17.4	2.3	1.0	1.7	0.0	20.3
4	Lady Jane	Bhatti Brothers	94.0	26.7	63.6	9.7	1.0	0.0	0.0	16.5
5	Lady Alicia	Bhatti Brothers	94.3	86.6	9.7	3.7	1.0	0.0	0.0	15.0
6	Red Bullet	Syko International	87.7	95.7	3.3	1.0	1.0	0.0	0.0	14.5
LSD 5%			4.25	3.75	9.80	6.56	N.S	.85	0.00	3.68
<i>Date of Planting</i> = 20.11.2019 <i>Date of Harvesting</i> = 21.04.2020										

From the above table it is evident that only the exotic variety “Sound” out yielded the local check varieties showing a yield of 23.6 T/ha, following the commercial check variety “Ruby” with the yield potential of 22.5 T/ha under Sahowali, Sialkot conditions. The locally developed variety “Sadaf” showed tuber yield of 20.3 T/ha. The lowest yield (14.5 t/ha) was produced by the exotic variety Red Bullet.

7. Early Bulking Potato Yield Trial

Two advanced potato lines were evaluated against four standard varieties i.e. Kuroda, Sante, SH-5 & Sahiwal White for their early bulking potential. The trial was planted on **23.10.2019** keeping 20cm plant to plant and 75cm row to row spacing with 6.0 m x 0.75 m plot size. The trial was laid out according to split plot design with 4 treatments i.e. harvesting after 60, 80, 100 & 120 days and three replications. The treatments were placed in main plots keeping in view their secondary importance and varieties in subplots due to their primary importance. Standardized agronomic practices were undertaken and necessary plant protection measures were adopted. The four treatments were harvested accordingly and data regarding emergence %age, tuber grades, marketable yield and total tuber yield were recorded.

Table No.23: Performance of strains/varieties in early bulking yield trial at PRI, Sahiwal

Treatments	Rank	Treatment	Emer. (%)	Tuber Grade (%)			Marketable Yield	Total Yield (t/ha)
				<35 mm	35-55mm	>55 Mm		
T1= Harv esting after 60 days	1	SH-5	94.3	60.7	39.3	0.0	6.5	11.0
	2	Sante	100.0	38.8	61.2	0.0	11.5	14.9
	3	Kuroda	99.0	57.9	42.1	0.0	8.6	12.3
	4	Sahiwal White	96.7	37.4	62.6	0.0	12.2	15.3
	5	FD-74-38	99.0	66.3	33.7	0.0	7.3	12.7
	6	FD-74-28	97.0	57.0	43.0	0.0	8.1	11.4
T2= Harv esting after 80 days	1	SH-5	98.0	31.3	57.5	11.2	18.3	20.4
	2	Sante	100.0	27.6	61.1	11.3	19.7	22.5
	3	Kuroda	100.0	29.7	56.8	13.5	19.7	22.8
	4	Sahiwal White	96.7	16.6	54.1	29.3	27.1	28.6
	5	FD-74-38	99.0	25.2	65.6	9.2	25.7	28.6
	6	FD-74-28	100.0	34.0	46.1	19.9	19.5	22.7
T3= Harv esting after 100 days	1	SH-5	97.7	24.7	55.5	19.8	25.8	27.9
	2	Sante	99.0	34.3	52.1	13.6	22.1	25.8
	3	Kuroda	98.0	28.4	58.9	12.7	23.1	25.3
	4	Sahiwal White	100.0	13.3	45.3	41.4	37.6	39.4
	5	FD-74-38	99.0	33.1	37.2	29.7	32.9	36.7
	6	FD-74-28	95.7	31.5	53.9	14.6	22.5	25.6
T4= Harv esting	1	SH-5	94.3	19.4	63.7	16.9	32.4	33.6
	2	Sante	100.0	18.0	72.3	9.7	27.4	28.7
	3	Kuroda	96.7	18.8	67.2	14.0	25.9	27.1

after 120 days	4	Sahiwal White	100.0	16.0	50.0	34.0	44.1	45.2
	5	FD-74-38	99.0	24.8	56.7	18.5	40.8	43.1
	6	FD-74-28	94.3	23.0	62.2	14.8	36.6	38.4
LSD 5%			3.9	13.6	16.9	11.6	5.4	5.2

The highest tuber yield in T1 was recorded from the local variety Sahiwal White (15.3 t/ha) followed by the commercial variety Sante which yielded 14.9 t/ha. The strains FD 74-38 & FD 74-28 produced the yield as 12.7 t/ha & 11.4 t/ha respectively. The highest tuber yield in T2 was recorded from the variety Sahiwal White and the strain FD 74-38 (28.6 t/ha each) followed by the commercial check variety Kuroda which yielded 22.8 t/ha. The highest tuber yield in T3 was recorded from the local variety Sahiwal White (39.4 t/ha) followed by FD 74-38 which yielded 36.7 t/ha. In T4, highest tuber yield was given by the local variety Sahiwal White (45.2 t/ha) followed by the strain FD 74-38 which yielded 43.1.

8. Evaluation of potato varieties against varied irrigation regimes

Four potato varieties were evaluated for their potential against drought stress tolerance. The trial was planted on **04.11.2019** keeping 20cm plant to plant and 75cm row to row spacing with 6.0 m x 1.5 m plot size. The trial was laid out according to split plot design with 3 treatments i.e. 7 days, 14 days & 21 days irrigation interval and three replications. The treatments were placed in main plots keeping in view their secondary importance and varieties in subplots due to their primary importance. The trial was irrigated normally in first month after sowing. The different treatments of irrigation intervals were started after one month of sowing (after completion of emergence).. Standardized agronomic practices were undertaken and necessary plant protection measures were adopted. Harvesting was done on **28.02.20**. Data regarding emergence %age, tuber grades, tuber diseases and tuber yield were recorded.

Table No. 24: Evaluation of advanced potato varieties against varied irrigation regimes

Treatments	Rank	Treatment	Emer. (%)	Tuber Grade (%)			Scab (%)	Rhiz. (%)	Crack (%)	Total Yield (t/ha)
				<35 mm	35-55mm	>55 mm				
T1=7 Days irrigation intervals	1	PRI Red	86.0	25.0	62.7	12.3	20.3	0.0	0.0	16.6
	2	Ruby	95.7	29.7	63.7	6.7	26.7	0.0	4.3	19.0
	3	Sadaf	96.7	25.7	66.7	7.7	19.7	0.0	0.0	29.8
	4	Barren	96.0	17.7	64.0	15.0	15.0	0.0	15.7	22.7
T2= 14 Days irrigation intervals	1	PRI Red	80.3	23.7	65.7	10.7	18.3	0.0	0.3	16.1
	2	Ruby	98.0	22.0	67.7	10.3	18.0	0.0	3.7	22.5
	3	Sadaf	97.7	16.0	72.0	8.7	17.3	0.0	0.0	32.4
	4	Barren	98.3	12.7	68.7	18.7	13.7	0.0	18.3	25.4
T3= 21 Days irrigation intervals	1	PRI Red	80.0	24.3	68.7	10.3	29.0	0.0	0.0	14.3
	2	Ruby	95.3	25.0	66.3	8.7	25.0	0.0	4.0	20.0
	3	Sadaf	97.7	17.7	75.3	10.3	16.7	0.0	0.0	33.4
	4	Barren	98.0	11.0	74.0	15.7	17.7	0.0	21.0	24.7
LSD 5%			12.2	8.8	10.8	5.6	14.0	NS	8.2	5.6

In T1, highest yield (29.8 t/ha) was recorded by the local variety Sadaf followed by the exotic variety Barren (22.7 t/ha). The lowest yield (16.6 t/ha) was recorded in the local variety PRI-Red. In T2, the highest yield (32.4 t/ha) was recorded in Sadaf followed by the exotic variety Barren which yielded 25.4 t/ha whereas the lowest yield was produced by the local variety PRI-Red (16.1 t/ha). In T3, the highest yield (33.4 t/ha) was recorded in the local variety Sadaf followed by the exotic variety Barren which yielded 24.7 t/ha whereas the lowest yield was given by the local variety PRI-Red (14.3 t/ha).

9. Seed increase of approved varieties of potato

Seed increase plots were space planted with 0.20 meter P x P & 0.75 meter R x R distance in non replicated strips according to the available quantity of seed potato of three approved varieties i.e. Faisalabad Red, Faisalabad White, PRI-Red, Ruby, Sadaf, Sahiwal Red, Sahiwal White, & Cosmo The material was sown under strict observation. The healthy plants were tagged on visual observation basis. Intense roughing was performed. The healthy and true to type material was harvested. A total of 5550 kg seed potato of approved varieties was produced..

10. Seed increase of promising lines of potato

Seed increase plots were space planted with 0.20 meter P x P & 0.75 meter R x R distance in non replicated strips according to the available quantity of seed potato of Four advanced strains / future varieties i.e. FD 76-59, FD 73-49, FD 73-44 & FD 81-1. The material was sown under strict observation. The healthy plants were tagged on visual observation basis. Intense roughing was performed. The healthy and true to type material was harvested. A total of 3950 kg of advanced potato strains was produced.

11. Minitubers production of approved potato varieties through Tissue Culture

Healthy plants of six approved potato varieties i.e. PRI-Red, Ruby, Sadaf, Sahiwal Red, Sahiwal White & Cosmo from the field were selected on the visual basis and tagged. Finally, disease-free plants were selected by performing the ELISA test. Explants from the meristems of above-mentioned plants were excised under aseptic conditions and cultured on MS medium in Tissue Culture Lab. The cultures were kept at 21-25 °C temperature in the incubation room under continuous illumination. The contaminated cultures were eliminated. Further micropropagation was done from nodal cuttings. The plantlets were shifted in the tunnel to produce minitubers. A total of 30 kg seed of BNS category of above mentioned varieties was produced.

12. Distinctive Uniformity Stability test of promising potato lines

This Institute got conducted 2nd year Distinctive, Uniformity & Stability test of two advanced potato strains i.e. FD 74-38 & SL 10-4 and 1st year DUS of SL 28-51 as pre requisite of variety approval.

13. Spot examination of candidate potato varieties

This Institute executed successful spot examination of two advanced candidate potato varieties i.e. Fareed (FD 73-44) & Ravi (FD 73-49) on 11.02.2020 at Potato Research Station, Sahowali (Sialkot) and 18.02.2020 at Potato Research Institute, Sahiwal as pre requisite of variety approval..

14. Inter provincial yield trial of approved potato varieties at PRI, Sahiwal

Ten potato varieties including seven varieties from PRI, Sahiwal, Punjab (PRI-Red, Ruby, Sadaf, Cosmo, Sahiwal White, Sahiwal Red & Sialkot Red) and three varieties from Gilgit Baltistan (GB-1, GB-2 & GB-3) were tested at Potato Research Institute Sahiwal. The material was sown on **24.10.2019**, keeping 20 cm plant to plant and 75 cm row to row distances. The plot size was kept 6.0 m x 2.25 m. The trial was laid out according to the Randomized Complete Block Design with three replications. Standardized agronomic and plant protection practices were adopted. Harvesting was done on **25.02.2020**. Data regarding emergence %age, tuber grades, disease infestation, and yield were recorded which are presented below:

Table No. 25: Performance of strains/varieties in Zonal Varietal Yield trial at PRI, Sahiwal

Rank	Variety	Emer. (%)	Tuber Grade (%)			Tuber Diseases (%)			Yield (t/ha)
			<35 mm	35-55mm	>55 mm	Scab	Rhiz.	Crack	
1	Cosmo	94.3	11.7	53.3	35.0	17.3	0.0	0.7	46.4
2	Sadaf	97.0	21.0	64.7	14.3	28.0	0.0	0.3	38.3
3	Sahiwal Red	95.7	13.0	69.7	17.3	32.0	0.0	0.7	37.9
4	Sahiwal White	94.7	15.3	60.4	24.3	28.0	0.0	1.3	36.5
5	GB-3	93.0	17.3	60.7	22.0	13.3	0.0	3.0	32.5
6	PRI-Red	87.0	20.7	61.6	17.7	24.3	0.0	7.3	28.5
7	Ruby	97.7	23.0	65.7	11.3	22.3	0.0	26.0	26.6
8	GB-2	99.3	17.3	61.7	21.0	6.0	0.0	1.3	23.7
9	GB-1	96.3	26.3	66.0	7.7	3.3	0.0	2.3	22.3
10	Sialkot Red	22.7	22.7	55.6	21.7	14.3	0.0	7.0	8.2
LSD 5%		5.98	10.15	15.40	8.39	12.80	N.S	6.53	9.51

In these studies it was observed that the potato variety Cosmo gave the maximum tuber yield (46.4 t/ha) followed by the variety Sadaf (38.3 t/ha). The potato varieties GB-1, GB-2 & GB-3 produced the yield as 22.3 t/ha, 23.7 t/ha & 32.5 t/ha respectively. Minimum yield (8.2

t/ha) was recorded from the variety Sialkot Red. The maximum emergence (99.3%) was recorded in the variety GB-2 whereas the minimum by the Sialkot Red (22.7%). Regarding Tuber grades, it was noted that the variety Cosmo produced maximum ration size tubers (35.0%). Maximum percentage of medium size tubers (69.7%) was produced by the variety Sahiwal Red. Regarding scab infestation, it was observed that the maximum scab incidence was observed on the variety Sahiwal Red (32.0%). All the entries showed tolerance against Rhizoctonia. Maximum cracks (26.0%) were observed in the local check variety “Ruby”.

B. POTATO RESEARCH STATION, SAHOWALI (SIALKOT)

Potato Research Station, Sahowali, Sialkot comprises of two Sub-stations i.e. one at Murree and one at Faisalabad. It was established initially in 1964 as Potato Research Station, Sialkot after shifting of its Headquarters from Murree to Sialkot. An area of 50.44 acres land was under its control. Since 1964 to the year 2012, all the area of 50.44 acres was transferred to various other Departments by the Government in public interest and no agricultural land was left for carrying out research experiments on Potato crop. In the year 2012, an area of 9.9 acres was allotted to this Station for conducting research experiments on Potato crop at Pulses Research Station, Sahowali, Pasrur Road Distt. Sialkot and the Potato Research Station was shifted to Sahowali, Sialkot. The Primary objectives of this Station are to develop new and improved varieties of Potato which are high yielding, tolerant to frost and diseases and possess good tuber quality characteristics with wider adaptability to different agro. ecological zones compared to the existing varieties in order to enhance Potato production in the province as well as in the country through introduction, selection, hybridization and improved crop growing techniques.

Table No.26: Station-wise detail of area

Sr.#	Name of Station	Total Area (Acres)	Cultivated Area (Acres)	Area under Road & Buildings (Acres)	Other than Area		
					Pattadar Area		
1	Potato Research Station Sahowali, Sialkot	11.1	9.9	1.2	-	1	Potato Research Station Sahowali, Sialkot
2	Potato Breeding Research Station, Murree	4.5	3.0	1.5		2	Potato Breeding Research Station, Murree
3	Potato Research Sub-Station, Faisalabad	-	-	-	-	3	Potato Research Sub- Station, Faisalabad
	TOTAL	15.6	12.9	2.7	-		TOTAL

Manpower.

The detail of manpower is given below in Table 27: -

Table No. 27: Detail of manpower

Sr.#	Name of Station	Scientific		Supporting		Ministerial	
		Total		Total		Total	
1	Potato Research Station Sahowali, Sialkot	Total	04	Total	12	Total	08
		Filled	01	Filled	09	Filled	06
		Vacant	03	Vacant	03	Vacant	02
2	Potato Breeding Research Station, Murree	Total	01	Total	06	Total	0
		Filled	01	Filled	03	Filled	0
		Vacant	0	Vacant	03	Vacant	0
3	Potato Research Sub- Station, Faisalabad	Total	01	Total	0	Total	01
		Filled	0	Filled	0	Filled	0
		Vacant	01	Vacant	0	Vacant	01

The main research activities performed at this station are as under: -

- i- Hybridization is carried out for creation of variability in the existing local as well as exotic varieties of Potato at Potato Breeding Research Sub-Station, Murree where flowering in Potato varieties takes place during July-August. The conditions are conducive for getting viable seed after crossing. Botanical seed in raised is nursery beds. Keen observations are taken from sowing to harvesting, like growth, leaf, stem characters, foliar, tuber diseases and tuber characters. The promising plants are selected for multiplication and further studies at Potato Research Station, Sahowali, Sialkot.
- ii- Introduction of exotic high yielding, diseases, frost tolerant varieties having good quality and other desirable characters.
- iii- Standardization of packages of crop production technology for new elite strains and low cost production techniques.
- iv- Pathological studies are carried out for control of Fungal, viral and other tuber diseases.
- v- Quality evaluation is carried out at Potato Research Sub-Station, Faisalabad.

During the year under report all the experiments were sown at proper time according to the Annual Programme of Research work covering important aspects of Potato crop. During summer 2019, new crosses were attempted at Potato Breeding Research Sub-station, Murree. Nursery was raised and screened from previous year's crosses. During

Autumn 2019-20, experiments were sown at Potato Research Station, Sialkot under normal crop growing conditions. The seed potato tubers were planted with plant to plant distance of 20cm and row to row distance 75cm followed by ridging. To control Weeds, suitable weedicides were sprayed upon the crop at initial stage of the crop and weeds were properly controlled. For the control of insect pests, fungal and other Potato diseases, the crop was sprayed with recommended doses of suitable insecticides and fungicides at regular intervals. The irrigation was applied as and when needed. Utmost efforts were made to give equal management to all the trials to keep the experimental error at minimum level.

WEATHER AND ITS EFFECTS

The meteorological parameters viz. Maximum, Minimum, Temperature, High velocity winds, Hail storm, Frost, Mist, Cloudy days and Rainfall recorded at Sahowali, Sialkot from 01-07-2019 to 30-06-2020 are given in Table No.28 below.

Table No. 28: Meteorological data recorded at potato research station, sahowali, sialkot during the year, 2019-2020

Sr. No	Month	Max. Temp. (Mean) C°	Min. Temp. (Mean) C°	No. of Frosty Days	Mist (Days)	High velocity wind (Days)	Hail-storm (Days)	No. of Cloudy days	Rain-fall mm
1	July, 2019	44.12	23.30			2	-	5	110.00
2	Aug., 2019	38.52	22.40			3	-	7	76.00
3	Sept., 2019	40.15	18.50			2	-	6	190.00
4	Oct., 2019	32.94	15.15			-	-	2	Nil
5	Nov., 2019	30.17	9.45			-	-	11	145.00
6	Dec., 2019	24.19	3.21	3		1	-	8	120.00
7	Jan., 2020	18.35	2.80	6	10	-	-	4	40.00
8	Feb., 2020	26.73	4.16	3	5	-	-	-	10.00
9	March, 2020	30.84	8.64			-	-	8	120.00
10	April, 2020	38.20	9.81			-	-	3	56.00
11	May, 2020	41.27	18.36			-	-	2	40.00
12	June, 2020	42.25	22.66			3	-	2	10.00
Total:-				12	15	11	Nil	58	917.00

A total of 917 mm of rainfall was received during the year under report compared to 872mm of rainfall of previous year. Less irrigation had to be applied to Rice crop as monsoon rain water kept standing in the fields. Land preparation for sowing of Rabi crops of Potato and Wheat for 2019-20 was carried out when the fields were found in ploughing condition. Potato experiments and seed multiplication crop was sown on an area of 5 acres. Wheat crop was also sown on an area of 3.5 acres for generating income. But its emergence was badly affected due to heavy rain spells during the whole winter season. Emergence of Potato crop and experiments

were good and crop stand was satisfactory at initial stage. But two acres of potato crop were also damaged very badly just after the emergence due to stagnant water of rains in the fields and that matter was also brought up in the notices of higher authorities. Fog and mist prevailed during most of the month of December 2019. No severe frost was observed during the month of January 2020 causing severe damage to the potato experiments and the crop. Due to high humidity and cold weather, sudden attack of Late blight of Potato was also noted on the crop during the months of January and February 2020 but it was adequately controlled by spraying fungicides on the crop at regular intervals. Harvesting of Potato experiments was started in the third week of February 2020. After repining during the month of April 2020, wheat crop was harvested.

1 - PRELIMINARY EVALUATION OF CROSSED MATERIAL DURING AUTUMN, 2019-2020

STUDY OF PROGENIES OF CROSSES MADE DURING 2017 and 2018

A total of 12 progenies from crosses of 2017 and 2018 were raised and studied according to augmented design with a plot size of 6 × 0.75 meters. Planting was done on 24-10-2019 and harvested on 03-03-2020. All the progenies were selected on overall basis as given below in Table No. 29.

Table No. 29: Detail of Progenies

Progenies planted (09)	Progenies selected (09)
SH-1812, SH-1813, SH-1816, SH-1819, SH-1823, SH-1824, SH-1827, SH-1828, SH-1829, SH-1835, SH-1838, SH-1841,	SH-1812, SH-1813, SH-1816, SH-1819, SH-1823, SH-1824, SH-1827, SH-1828, SH-1829, SH-1835, SH-1838, SH-1841,

	Variety	Tuber Grade (%)			Tuber Disease (%)			Yieldt/ha.
		>55 mm	35-55 mm	<35 mm	Scab	Rhiz	Crack	
1	SH-1812	6.66	56.68	36.66	3	1	-	21.97
2	SH-1813	3.66	50.34	46.00	3	-	-	26.68
3	SH-1816	3.33	52.68	43.66	7	2		27.31
4	SH-1819	2.66	38.66	58.66	6	1		21.71
5	SH-1823	13.66	55.01	31.33	3	1	-	27.21
6	SH-1824	19.00	54.34	26.66	4	1		18.51
7	SH-1827	5.00	44.34	50.66	5	1	-	17.17
8	SH-1828	0.33	50.34	49.33	3			19.13
9	SH-1829	10.66	64.34	25.00	5	2		21.00
10	SH-1835	0.33	42.67	57.00	3	2		19.88
11	SH-1838	6.66	51.01	42.33	5	3		28.24
12	SH-1841	3.66	55.34	41.00	4	2		26.46
13	PRI-Red	10.66	52.34	37.00	5	2		11.95

14	Sadaf	19.00	55.00	26.00	6	3		23.68
15	Sialkot Red	12.33	66.34	21.33	2	-		31.62
LSD at 0.05 level		4.65	5.32	6.13	2.16	1.25		3.04

A line –SH-1838 showed maximum yield as 28.24 followed by a line SH-1816 and SH-1823 with the yield potential of 27.31 and 27.21 respectively tons per hectare. But did not exceed the check variety Sialkot Red which yield potential was recorded as 31.62 tons per hectare.

2 - SECONDARY EVALUATION OF SIXTEEN RED AND WHITEPOTATO STRAINS/ VARIETIES FOR THEIR YIELD POTENTIAL AND OTHER DESIRABLE TRAITS 2019-20

The varieties included in this experiment comprised of sixteen promising strains/varieties including checks. These were planted on 23-10-2019 according to Randomized Complete Block design with three replications, keeping plot size of 6 m x 2.25m for selecting new high yielding desirable strains. The trial was harvested on 02-03-2020. Data on tuber grades, tuber diseases and tuber yield were recorded and presented in Table No.30: -

Table No.30: Results of Secondary evaluation Trial

Rank	Variety	Tuber Grade (%)			Tuber Disease (%)			Yieldt/ha.
		>55 mm	35-55 mm	<35 mm	Scab	Rhiz	Crack	
1	SH-1801	14.66	61.34	24.00	3.66	0.33	-	13.36
2	SH-1802	5.33	13.04	31.66	3.33	1	-	16.33
3	SH-1803	13.66	51.34	30.00	2.66	0.66	-	20.36
4	SH-1805	15.66	58.34	26.00	2.66	-	-	18.33
5	SH-1807	19.00	58.67	22.33	1.66	1.33	-	16.92
6	SH-1808	20.35	50.32	29.33	2.33	.033	-	15.05
7	SH-1809	10.33	54.34	35.33	3.33	0.33	-	19.45
8	SH-1810	7.66	66.68	25.66	2.33	0.33	-	23.53
9	SH-1811	9.00	69.00	22.00	2.33	1	-	16.56
10	SADAF	18.33	58.04	23.66	9.33	1.66	-	21.51
11	RUBY	10.33	66.70	23.00	4.33	.66	-	22.81
12	PRI-RED	20.33	55.67	24.00	1.33	1	1.33	17.77
LSD at 0.05 level		7.13	5.92	6.20	2.55	1.97	0.44	3.21

The variety SH-1810 showed the best yield of 23.53 tons/hectare followed by the check variety Ruby with a yield of 22.81 tons/hectare and a line SH-1803 with a yield of 20.36 tons/hectare. This one line SH-1810 exceeded in yield than the check varieties SADAF, RUBY

and PRI-RED with their respective yield as 21.51, 22.81 and 17.77 tons/hectare. The promising line SH-1810 will be selected for inclusion in further breeding yield trials.

3- REGULAR VARIETAL YIELD TRIALS WITH NEW POTATO STRAINS/VARIETIES 2019-20

11 varieties/lines in the experiment were comprising including checks as given below Table No. 31.

Table No. 31: List of entries

7 strains/varieties (4checks)	SH-1643, SH-11650, SH-1658, SH-1788, SH-1792, SH-1795, SH-1799 PRI-RED (Check), Ruby (Check), Kuroda (Check)and Sialkot Red (Check)
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Experiment was sown on 23-10-2019 according to Randomized Complete Block design with three replications for selecting new promising varieties/ strains. The size of plot was kept 6 m x 2.25 m. Trial was harvested on 27-02-2020. Data on emergence percentage, tuber grades, tuber diseases and tuber yield were recorded and showed below in Table No. 32: -

Table No. 32: Results of regular varietal yield trial

S. No	Variety	Emergence (%)	Tuber Grade (%)			Tuber Disease (%)			Yield/ha.
			>55 mm	35-55 mm	<35 mm	Scab	Rhiz.	Crack	
1	SH-1643	99.66	22.30	59.34	18.33	5.33	0	0.66	30.14
2	SH-1650	99.00	17.00	54.67	28.33	2.66	1	-	27.87
3	SH-1658	98.00	23.66	58.34	18.00	9.00	3.66	1	21.38
4	SH-1788	99.33	11.66	58.01	33.33	8.66	7.66	1.33	16.68
5	SH-1792	98.00	29.66	54.01	16.33	1.66	0.33	-	36.46
6	SH-1795	97.33	19.33	55.67	25.00	2.66	0	-	26.34
7	SH-1799	97.00	11.66	66.74	33.66	4.66	0	-	18.00
8	Sialkot Red	98.33	32.33	53.67	14.00	0	0.33	-	35.72
9	KURODA	97.66	11.33	57.67	31.00	5.66	1.33	-	17.05
10	PRI-RED	96.66	18.33	59.67	22.00	2.66	1.33	-	15.98
11	RUBY	99.00	8.33	67.34	24.33	3.66	7	1.66	23.89
LSD at 0.05 level		2.49	3.62	3.41	5.82	2.17	1.37	1.12	3.17

Above analyzed data revealed that the line/variety SH-1792 and Sialkot Red were observed at top ranking with tuber yield of 36.46, 35.72 tons per hectare followed by the lines/varieties SH-1643, and SH-1650 with the yield potential of 30.14 and 27.87 tons per

hectare respectively comparing with the yield of 17.05, 15.98, 23.89 tons per hectare of check varieties viz., Kuroda, PRI-RED and RUBY.

C. POTATO BREEDING RESEARCH SUB-STATION, MURREE

1. HYBRIDIZATION

A total of 77 crosses were attempted for obtaining crossed berries between different selected parent potato / strains during summer,2018. Out of 77 crosses, 40 crosses were successful and 353 berries were obtained form 40 cross combinations for nursery raisers during summer 2019. The detail of crosses is given in Table No. 33

Table No.33: Detail Of Cross Combinations and Berries

Sr. No.	Cross Combination	Name of Berries
1	SH-718 X Simply Red	20
2	SH-718 X SH-1644	03
3	Cardinal X SH-1035	01
4	SH-718 X SH-1206	05
5	SH-718 X SH-1643	08
6	Cardinal X Simply Red	07
7	Kuroda X FD81-1	04
8	SH-718 X SH-5	16
9	Sadaf X Hermes	01
10	FD 76-59 X FD 73-49	05
11	Kuroda X Ruby	07
12	SH-1638 X SH-1206	03
13	Ruby X FD81-1	05
14	FD73-44 X sadaf	08
15	Astrix X SH-718	04
16	Astrix X SH-1206	09
17	FD 76-59 X Sadaf	05
18	SH-718 X Lady Rositta	05
19	SH-1643 X SH-5	04
20	SH-718 X SH-1638	20
21	Dimant X SH-5	02
22	SH-718 X PRI Red	23
23	FD 78-51 X Sadaf	20
24	SH-78-51 X Ruby	35
25	Astrix X PRI Red	24
26	Sadaf X FD81-1	02
27	Sadaf X PRI Red	06
28	Dimant X Kuroda	02
29	Astrix X K-Frysona	05
30	Astrix X Ruby	10
31	SH-718 X FD 73-44	15
32	Kuroda X PRI-Red	02
33	SH-718 X Kuroda	09

34	SH-1643 X PRI-Red	08
35	SH-718 X Ruby	16
36	SH-1643 X SH-718	06
37	K-Frysona X FD74-30	06
38	Sante X PRI-Red	07
39	Cereza X FD73-44	11
40	Santé X FD73-49	05

2- SELECTION OF DESIRABLE GENOTYPES FROM CROSSES OF 2017.

A total of 43 successful cross combination harvested during 2017 were sown in pots and 41 cross combination were raised successful in pots. Details of these crosses 2017, plant number selected and number of tubers of each plant is given below in Table.34.

Table No.34: Detail of selected genotypes from crosses of 2017

Sr. No.	Cross Combination	Plant No.	No. of Tubers
1	Karuda X FD73-49	P1	7
	-	P2	5
	-	P3	1
	-	P4	2
	-	P5	2
	-	P6	1
	-	P9	1
	-	P12	4
	-	P13	4
	-	P14	8
	-	P15	6
	-	P16	12
	-	P17	5
2	Karuda X SH-5	P1	1
	-	P2	3
	-	P3	9
	-	P4	27
	-	P8	4
	-	P9	5
	-	P11	7
	-	P12	7
	-	P15	2
	-	P16	5
	-	P17	5
	-	P19	10
	-	P20	8
	-	P21	8
	-	P22	6
	-	P23	12
	-	P25	11
3	SH-795 X SH-718	P1	2
	-	P2	2

	-	P3	2
	-	P4	1
	-	P8	3
	-	P9	2
	-	P11	4
	-	P13	8
4	SH-5 X SH-795	P1	3
	-	P4	5
	-	P5	4
	-	P7	2
	-	P8	3
	-	P10	1
	SH-1644 X SH-5	P1	4
	-	P4	2
	-	P5	2
	-	P8	6
	-	P10	11
	-	P12	10
5	SH-1644 X SH-1655	P1	3
	-	P5	4
	-	P8	3
6	SH-1644 X Karuda	P3	6
	-	P4	8
	-	P7	3
	-	P8	4
	-	P9	5
	-	P11	3
	-	P12	5
	-	P13	9
7	SH-5 X PRI-Red	P1	1
	-	P3	4
	-	P4	2
	-	P5	6
	-	P8	1
	-	P10	6
	-	P11	9
	-	P12	3
	-	P14	5
	-	P15	9
8	SH-5 X Kuroda	P1	3
		P4	3
		P5	3
		P6	3
		P9	2
		P10	3
		P11	1
		P13	8
		P14	6
9	SH-5 X FD73-49	P1	5
	-	P3	3

	-	P5	3
	-	P8	4
	-	P9	2
	-	P10	2
	-	P12	4
10	SH-729 X SH-1655	P1	4
	-	P2	4
	-	P5	4
	-	P6	1
	-	P8	3
	-	P9	2
	-	P10	6
	-	P11	4
	-	P12	8
	-	P15	6
11	FD35-36 X SH-5	P2	5
	-	P5	2
	-	P6	10
	-	P8	4
12	SH-795 X SH-1644	P1	4
	-	P2	2
	-	P6	2
	-	P8	3
13	FD 35-36 X Sasaf	P1	5
	-	P4	7
	-	P7	4
	-	P8	7
	-	P9	5
	-	P10	10
14	FD 73-73 X Sadaf	P1	2
	-	P2	5
	-	P5	3
	-	P6	3
	-	P8	9
	-	P9	11
	-	P11	6
15	FD- 35-36 X SH-5	1	1
	-	P2	4
	-	P5	7
16	SH-729 X SH-1664	P1	1
	-	P4	5
	-	P5	4
	-	P6	2
	-	P7	3
	-	P8	7
	-	P10	3
	-	P11	12
17	SH-729 X FD78-51	P1	2
	-	P2	4
	-	P5	5

18	SH-5 X SH-1644	P1	2
	-	P2	2
	-	P3	1
	-	P4	3
	-	P6	1
	-	P8	4
	-	P10	2
	-	P11	3
	-	P12	8
	-	P13	6
	-	P15	9
19	SH-1644 X PRI-Red	P2	2
	-	P5	3
	-	P6	4
20	SH-795 X Kuroda	P1	8
	-	P2	5
	-	P6	10
	-	P7	4
	-	P8	4
21	SH-1644 X Diamant	P1	1
	-	P2	1
	-	P4	6
	-	P6	3
	-	P7	2
	-	P8	3
	-	P10	9
22	SH-729 X SH-718	P1	5
	-	P2	4
	-	P4	6
	-	P7	2
	-	P8	13
	-	P9	8
	-	P10	12
	-	P11	10
	-	P13	15
	-	P15	13
23	SH-5 X SH-1643	P1	5
	-	P3	3
	-	P4	6
	-	P5	5
	-	P6	2
	-	P8	10
	-	P10	5
24	SH-795 X Kuroda	P3	4
	-	P4	3
	-	P6	3
	-	P7	4
	-	P8	3
25	Kuroda X FD 73-44	P1	1
	-	P2	4

	-	P3	1
	-	P5	3
26	SH-795 X SH-5	P3	2
	-	P4	2
	-	P5	3
	-	P7	4
	-	P8	2
	-	P10	5
	-	P11	2
	-	P13	5
	-	P14	6
	-	P15	12
27	SH-795 X SH-1643	P1	3
	-	P2	5
	-	P3	6
	-	P4	4
	-	P8	5
	-	P9	10
	-	P10	5
28	FD73-110 X SH-5	P3	5
	-	P4	2
	-	P6	6
	-	P7	3
	-	P8	10
	-	P9	13
	-	P10	9
	-	P12	5
29	SH-795 X SH-1655	P1	3
	-	P3	4
	-	P5	6
	-	P8	4
	-	P9	5
	-	P10	2
	-	P11	10
	-	P12	9
30	Kuroda X PRI- Red	P3	1
	-	P4	5
	-	P6	4
	-	P7	1
	-	P8	4
	-	P10	5
	-	P11	1
	-	P12	10
	-	P13	8
	-	P15	10
31	Fsd White X Ruby	P1	1
	-	P2	1
	-	P3	5
	-	P5	3
	-	P7	7

32	FD 78-51X SH-5	P4	2
	-	P5	7
	-	P6	2
	-	P7	2
	-	P8	6
	-	P10	7
33	FD35-36 X FD81-1	P1	2
	-	P2	3
	-	P8	3
	-	P9	10
	-	P10	5
	-	P12	7
34	SH-5 X FD73-44	P4	1
	-	P5	5
	-	P6	3
	-	P7	5
	-	P8	9
	-	P9	6
	-	P10	7
	-	P11	5
	-	P13	8
	-	P14	5
	-	P16	10
	-	P17	6
35	SH-1644 X SH-795	P1	2
	-	P2	1
	-	P3	5
	-	P5	4
	-	P7	8
	-	P10	3
36	PRI-Red X FD 78-51	P2	4
	-	P3	1
	-	P5	4
	-	P6	2
37	FD73-73 X SH-5	P1	5
	-	P2	5
	-	P3	4
	-	P4	1
	-	P8	3
	-	P9	9
	-	P10	5
38	Kuroda X FD 76-18	P1	1
	-	P3	2
	-	P4	5
	-	P5	5
	-	P8	6
39	SH-729 X SH-1638	P5	2
	-	P6	2
	-	P7	4
	-	P8	9

	-	P9	6
	-	P10	9
	-	P12	5
	-	P15	6
	-	P16	4
40	FD 35-36 X FD 76-59	P1	4
	-	P2	4
	-	P4	5
	-	P6	7
41	SH-5 X FD 78-51	P1	3
	-	P2	2
	-	P4	5

2. PLANT PATHOLOGY:

A. Potato Research Institute Sahiwal:

1. Effect of seed treatment for the management of Rhizoctonia disease of potato.

A trial was devised for the control of Rhizoctonia disease of potato. The main objective was to search out the most efficacious fungicide for seed treatment for economical control of potato tuber's disease. The experiment was sown on **01-11-2018** in RCB Design with three replications and 6.0 m x 1.5 m of plot size. Four different fungicides (T1= Celest @ 40ml / 100kg seed, T2 – Moncut @ 15ml / 100kg seed, T3 = Imisto @ 100ml / 100kg seed & T4= Triton @ 8ml /100kg seed) in comparison with control (T5) were applied as seed treatment to check their effect on Rhizoctonia disease. Standardized agronomic and plant protection measures were carried out in the crop. Harvesting was done on **27.02.2020**. Data regarding emergence percentage, tuber grades, disease incidence and yield were recorded and given in Table No.35. Potato seed was treated with the recommended dose of fungicides before sowing whereas in case of control, the seed was not treated with any chemical.

Table No.35: Impact of seed treatment on Rhizoctonia disease at PRI, Sahiwal

Rank	Treatment	Emer. (%)	Tuber grades (%)			Rhiz. (%)	Yield (t/ha)
			<35 (mm)	35-55 (mm)	>55 (mm)		
1	T1= Celest @ 40ml / 100 kg seed	98.3	24.7	61.3	14.0	0.0	30.6
2	T2= Moncut @ 15ml / 100 kg seed	99.0	26.3	58.0	15.7	0.0	33.5
3	T3= Imisto @ 10ml / 100 kg seed potato	97.0	20.7	62.0	17.3	1.7	32.9
4	T4= Triton @ 8ml / 100 kg seed potato	97.7	20.3	65.7	14.0	0.3	32.5
5	T5= Control	98.7	19.0	66.3	14.7	26.0	34.5
LSD 5%							

It is revealed from the results presented above that no disease incidence regarding black scurf was observed with the application of Celest (T1) & Moncut (T2) each. 0.3% & 1.7% disease incidence was observed in T4 (Triton) & T3 (Imisto) respectively. The highest disease incidence (26.0%) was observed in T5 (control). Maximum yield (34.5 t/ha) was observed in T5 (Control) followed by T2 which yielded 33.5 t/ha, whereas minimum yield (30.6 t/ha) was observed in T1.

2. Testing of different doses of Fludioxonil for the control of common scab disease in Potato.

A trial was devised for the control of Common Scab disease of potato. The main objective was to search out the most efficacious dose of Fludioxonil / Celest for seed treatment for economical control of potato tuber's disease. The experiment was sown on **01-11-2019** in RCB Design with three replications and 6.0 m x 2.25 m of plot size. The test line **FD 76-67** was used in all four treatments namely; T1= Celest @ 40ml / 100 kg seed, T2= Celest @ 50ml / 100 kg seed, Celest @ 60ml / 100 kg seed & T4= Control. Standardized agronomic and plant protection measures were carried out in the crop. Harvesting was done on **27.02.2020**. Data regarding emergence percentage, disease incidence and yield were recorded.

Table No.36: Effect of different doses of Fludioxonil / Celest for the management of Common Scab at PRI, Sahiwal

Rank	Treatment	Emer. (%)	Tuber grades (%)			Common Scab (%)	Yield (t/ha)
			<35 (mm)	35-55 (mm)	>55 (mm)		
1	T1= Celest @40ml / 100 kg seed	92.6	12.3	69.7	18.0	35.3	34.2
2	T3= Celest @ 60ml / 100 kg seed	94.5	10.7	72.0	17.3	47.3	34.9
3	T2= Celest @ 50ml / 100 kg seed	97.0	16.0	64.7	19.3	36.0	35.7
4	T4= Control	97.8	15.3	65.0	19.7	47.0	36.9
LSD 5%		7.17	4.67	13.05	4.53	6.11	3.68

It is evident from the results of this study presented above that the minimum disease incidence regarding common scab was observed in T1 (35.3%) followed by T3 which showed 36.0% disease incidence. The maximum incidence of common scab (47.3%) was observed in T2. Maximum yield (36.9 t/ha) was observed in T4 (Control) followed by T3 which yielded 35.7 t/ha, whereas minimum yield (34.2 t/ha) was observed in T1.

3. Effect of Irrigation frequency on the incidence of common scab

Two different irrigation intervals viz: Irrigation after 3-4 days (Twice a week) & Irrigation after 7-8 days (Once a week) were evaluated to check their effect on the incidence of common scab disease of potato at Potato Research Institute, Sahiwal. The material was sown on **04.11.2019**, keeping 20 cm plant to plant and 75 cm row to row distances. The plot size was kept 6.0 m x 2.25 m. The trial was laid out according to the Randomized Complete Block Design with three replications. Standardized agronomic and plant protection practices were adopted. The susceptible strain against common scab “FD 76-67” was used to conduct the trial. The T2 started after 40 days of sowing (at the time of tuberization). Harvesting was done on **02.03.2020**. Data regarding emergence %age, tuber grades, disease infestation and yield were recorded which are presented below.

Table No.37: Effect of different irrigation intervals on incidence of Common Scab at PRI, Sahiwal

Rank	Treatment	Emer. (%)	Tuber grades (%)			Common Scab (%)	Yield (t/ha)
			<35 (mm)	35-55 (mm)	>55 (mm)		
1	T1= Once a week	92.3	11.7	78.0	10.3	16.7	30.6
2	T2= Twice a week	93.3	6.7	81.3	12.0	14.0	29.8
LSD 5%		21.66	8.96	12.50	3.79	14.13	5.35

It is revealed from the results presented above that Minimum disease incidence regarding common scab was observed in T2 (14.0%). The maximum diastase incidence was observed in T1 (16.7%). Maximum yield (30.6 t/ha) was observed in T1 whereas minimum yield (29.8 t/ha) was observed in T1.

B. POTATO RESEARCH STATION, SAHOWALI (SIALKOT)

1. EVALUATION OF THIRTY PROMISING LOCAL GENOTYPES FOR RESISTANCE/TOLERANCE AGAINST FOLIAR AND TUBER DISEASES.

A field experiment comprising thirty potato genotypes was planned to evaluate their resistance/tolerance potential against major foliar and tuber disease. For this purposes, thirty elite varieties/lines were planted on 02-11-2019 along with two check/standard varieties viz, cardinal and SH-5. All the genotypes were planted in 6-meter-long single row plots. Normal agronomic practices were carried out and no fungicide was sprayed.

Data on incidence of different parameters, foliar diseases viz, late blight, potato virus (PVX), potato virus Y (PVY), potato leaf roll virus (PLRV) and tuber diseases i.e. Common scab, Rhizoctonia and tuber cracking were recorded table No.38.

Table No. 38: Evaluation against foliar and tuber diseases

S. No.	Variety/ line	Emer %	Blight %	Scab %	Rhz %	Crack %	Rot %	PVX %	PV-Y %-	PLRV %	Yield T/hac.
1	SH-5	80%	100	20	10	5	-	-	-	50	23.15
2	SH-1213	100%	-	-	-	-	-	-	-	-	28.33
3	SH-1733	91%	10	-	-	-	-	--	-	-	19.24
4	SH-1736	88%	10	-	-	-	-	-	-	-	19.77
5	SH-1740	90%	20	-	-	5	-	-	-	-	22.75
6	SH-1743	85%	15	-	-	-	-	-	-	-	19.80
7	SH-1745	83%	10	-	-	-	-	--	-	-	18.66
8	SH-1750	87%	20	-	-	-	-	-	-	-	22.08
9	SH-1777	92%	20	-	-	-	-	-	-	-	24.75
10	SH-1778	83%	20	-	-	3	-	-	-	-	20.60
11	SH-1786	89%	25	-	-	5	-	-	-	-	18.11
12	SH-1788	90%	20	-	-	-	-	-	-	-	23.51
13	SH-1792	100%	-	-	-	-	-	-	-	-	45.40
14	SH-1795	99%	-	-	-	-	-	-	-	-	37.62
15	SH-1799	87%	10	-	-	-	-	-	-	-	26.06
16	SH-1801	83%	15	-	-	-	-	-	-	-	31.11
17	SH-1802	80%	10	-	-	-	-	-	-	-	20.22
18	SH-1803	81%	5	-	-	-	-	-	-	-	24.28
19	SH-1805	80%	5	-	-	-	-	-	-	-	19.22
20	SH-1808	84%	10	-	-	-	-	-	-	-	23.73
21	SH-1809	82%	10	-	-	-	-	-	-	-	19.22
22	SH-1811	80%	5	-	-	-	-	-	-	-	27.17
23	Ruby	100%	10	-	-	-	-	-	--	-	28.60
24	Pri-Red	80%	80	10	-	-	-	--	-	60	19.46
25	Diamant	99%	100	30	80	15	-	-	-	20	23.40
26	Kuroda	86%	40	30	20	10	-	-	-	10	24.86
27	Cardinal	98%	100	20	65	-	-	-	-	20	26.20
28	Sialkot Red	99%	5	-	-	-	-	-	-	-	40.82
29	Sadaf	99%	15	-	-	-	-	-	-	-	29.24
30	Sante	98%	10	-	-	-	-	-	-	-	23.81

FOLIAR DISEASES.

EARLY BLIGHT DISEASE.

The weather proved unfavorable for the onset of the disease, so the disease was observed only in negligible portions.

LATE BLIGHT DISEASE INCIDENCE.

Among thirty lines/varieties screened against late blight of Potato, only 3 lines/varieties remained free from the disease. Four lines/varieties were found with least -disease incidence as 5%. Whereas a variety PRI-Red possessed 80% disease incidence followed by a commercial variety Kuroda showed 40 disease incidence. Among check varieties, SH-5, Diamant and Cardinal exhibited high level of disease incidence as 100%.

POTATO VIRUS X (PVX).

Among thirty genotypes of Potato sown for screening purposes, all the entries showed no visible symptoms against (PVX).

POTATO VIRUS Y (PVY).

Among the 30 lines/varieties, no visible symptoms against (PVY) were recorded.

POTATO LEAF ROLL VIRUS (PLRV)

Among the 30 lines/varieties, 25 lines/varieties did not express visible symptoms against (PLRV). Kuroda showed 10% disease incidence, where as 20% visible symptoms were recorded on check varieties Diamant and Cardinal. Maximum infection level as 60% was recorded on a variety PRI-Red followed by 50% infection level on a variety SH-5.

TUBER DISEASES

COMMON SCAB DISEASE INCIDENCE.

Among thirty Potato germplasm, twenty-five lines/varieties were found to be free of the disease. 20% disease incidence was observed on the potato variety SH-5 and Cardinal. PRI-Red showed 10% disease incidence while maximum disease incidence as 30% was recorded on a variety Diamant and Kuroda

BLACK SCURF (RHIZOCTONIA SP).

Among thirty genotypes, twenty-six lines were observed free from the disease. 10% and 20% disease were recorded on two varieties SH-5 and Kuroda. Maximum disease incidence 80% was observed on Diamant.

TUBER CRACKING

Among thirty genotypes sown for screening purposes, tuber cracking symptoms were observed on six entries. Maximum tuber cracking was observed on a variety Diamante as 15 %.

TUBER YIELD

One line viz. SH-1792 proved to be the highest yielder with the maximum potato yield of 45.40 t/ha followed by four genotypes of Sialkot-Red, SH-1795, SH-1801 and Sadaf with their tuber yield as 40.80, 37.62, 31.11 and 29.24 t/ha respectively. Minimum tuber yield was recorded on a line/ variety SH-1786 with a magnitude of 18.11 t/ha given in Table No. 38.

2. CONTROL OF LATE BLIGHT OF POTATO THROUGH DIFFERENT FUNGICIDES.

An experiment with five different fungicides was planned in order to find out the most efficacious fungicide for the control of late blight disease and highest potato yield. The trial was carried out having RCBD design, with three replications and 2.8 x 6 m plot size. Row and plant spacing were maintained as 70 cm and 20 cm respectively. The test variety SH-5 was planted on 24-10-2019. Five fungicides namely; Ridomil Gold, Curzate, Defeater, Melody Dew, and Mancozeb were included in the trial. Fungicidal sprays were done according to the schedule. While in control, no spray was carried out. The standard agronomic practices were followed for better establishment of crop stand and development.

LATE BLIGHT DISEASE INCIDENCE PERCENTAGE.

Among all the treatments, statistically analyzed data revealed that treatment No.1 proved efficacious with the least disease incidence as 8.83% as compared to control possessing 100% disease incidence given in Table No.39.

Treatment No.2 expressed 11.60% disease incidence percentage followed by T3 and T4 with the result of 13.80% and 17.43% respectively. Treatment No.5 also showed less disease incidence percentage compared with that of control.

Table No.39: Late blight studies

Sr.No.	Treatments	Disease percent mean	Percent decrease /control	Yield T/ha
1	Spray of Ridomil Gold @2.5g/lit	8.83	91.17	27.75
2	Spray of Curzate @600g/Acre	11.60	88.40	27.25
3	Spray of Defeater @2.5g/lit	13.80	86.20	26.31
4	Spray of Melody Dew@300g/Acre	17.43	82.57	25.62

5	Spray of Mancozeb @2.5g/lit	19.55	80.45	25.18
6	Control	100	-	24.03
LSD at 0.05 level		2.17		1.85

TUBER YIELD.

It was revealed from the given values in Table No.39, that maximum tuber yield 27.75 t/ha was observed in treatment No.1. Control proved to be the least potato tuber yielder with a magnitude of 24.03 t/ha.

3. CHEMICAL CONTROL OF BLACK SCURF (RHIZOCTONIA SP) THROUGH SEED TREATMENT.

A trial was laid out for the control of Rhizoctonia disease of potato tubers. The main objective was to search out the most effective fungicide for seed treatment of potato tubers proving to be economical in controlling potato tuber diseases. The experiment was sown on 24-10-2019 with RCBD design having plot size 2.8x6m. The test variety Cardinal was sown with three replications along with six treatments namely, Monceren @1ml/kg seed tuber, Triton @8ml /100kg seed tuber, Moncut @ 15ml/100 kg seed tuber, Celest @ 40ml/100 kg seed tuber, Mancozeb 2g /kg seed tuber and untreated seed (control). Data on all the parameters were recorded and potato seed was treated with the selected dose of fungicides before sowing whereas in case of control, seed was not treated with any chemical Table No.40.

Table No.40:Chemical Control of Black Scurf

Treatments	Ave. dis. %	Percent dec./ over cont	Yield T/ha.
T1 Monceren @ 1ml/kg seed tuber	3.98	95.77	24.06
T2 Celest @ 40ml/100kg seed tuber	5.15	94.53	23.85
T3 Moncut @ 15ml/100kg seed tuber	5.81	93.82	23.32
T4 Triton @8ml/100kg seed tuber	8.55	90.91	22.84
T5Mancozeb 2g/kg seed tuber	15.40	83.64	21.52
T6 Untreated seed (control)	94.15	-	19.84
LSD at 0.05 level	3.05		1.98

Rhizoctonia disease.

Statistical analysis revealed differences among all the treatments and found non-significant. In treatment No.1, disease percentage decrease over control with a value of 95.77% was recorded followed by T2 with the value of 94.53 disease percentage decrease over control.

Tuber yield.

The results with their mean values differences showed that treatment No.1.possessed the maximum tuber yield as 24.06t/ha followed by T2 with the magnitude of 23.85 t/ha yield. T6 untreated seed (control) turned out to be the lowest potato tuber yielder as 19.84 t/ha.

3. AGRONOMY:

A. POTATO RESEARCH INSTITUTE, SAHIWAL:

1. Impact of Nitrogen split on yield of potato

Five different splits of Nitrogen fertilizer viz: T1= 1 split (100% at the time of sowing), T2= 2 splits (50% at the time of sowing & 50% after 35-40 days of sowing), T3= 3 splits (33% at the time of sowing, 33% after 35 days of sowing & 33% after 55 days of sowing), T4= 4 splits (25% at the time of sowing, 25% after 30 days of sowing, 25% after 45 days of sowing & 25% after 60 days of sowing), T5= 5 splits (20% at the time of sowing, 20% after 30 days of sowing, 20% after 40 days of sowing, 20% after 50 days of sowing & 20% after 60 days of sowing) were tested at Potato Research Institute, Sahiwal. The material was sown on **08.11.2019**, keeping 20 cm plant to plant and 75 cm row to row distances. The plot size was kept 6.0 m x 2.25 m. The trial was laid out according to the Randomized Complete Block Design with three replications. Standardized agronomic and plant protection practices were adopted. Harvesting was done on **16.03.2020**. Data regarding emergence %age, tuber grades and yield were recorded which are presented below:

Table No.41: Impact of Nitrogen split on yield at PRI, Sahiwal

Rank	Treatment	Emer (%)	Tuber Grade (%)			Yield (t/ha)
			<35 mm	35-55mm	>55 mm	
1	T5= 5 splits	88.3	26.7	64.6	8.7	30.5
2	T4= 4 splits	87.3	24.3	68.7	7.0	29.7
3	T2= 2 splits	85.0	28.0	61.3	10.7	26.1
4	T3= 3 Splits	85.7	27.3	64.0	8.7	25.9
5	T1= 1 splits	71.0	23.0	65.0	12.0	23.0
LSD 5%		4.85	7.35	8.26	4.69	4.70

It is revealed from the results presented above that T5 produced maximum yield (30.5 t/ha) followed by T4 which yielded 29.7 t/ha. The lowest tuber yield was given by T1 (23.0 t/ha). The application of nitrogen fertilizer in five splits gives best results in terms of tuber yield. The maximum emergence (88.3%) was recorded in T5. Regarding Tuber grades, it was noted that T1 produced maximum ration size tubers (12.0%). Minimum percentage of small size tubers (28.0%) was produced by T2 whereas maximum percentage of medium size tubers was produced by T4 (68.7%).

2. Sowing of potato in different dates to gain maximum potato yield under changing climate scenario.

Four different sowing dates (T1= 23.10.19, T2= 31.10.19, T3= 08.11.19 & T4= 16.11.19) with eight day interval were studied to find out the best sowing season for potato crop under changing climate scenario keeping 20cm plant to plant and 75cm row to row spacing with 6.0 m x 2.25 m plot size. The trial was laid out according to the Randomized Complete Block Design with three replications. Standardized agronomic and plant protection practices were adopted. The trial was provided with 100 days growing period. Harvesting was done on T1= 03.02.20, T2= 11.02.20, T3= 19.02.20 & T4= 27.02.20. Data regarding emergence %age, tuber grades, disease infestation, and yield were recorded which are presented below:.

Table No.42: Impact of different sowing dates on yield of potato at PRI, Sahiwal

Rank	Variety	Emer. (%)	Tuber Grade (%)			Tuber Diseases (%)			Yield (t/ha)
			<35 mm	35-55mm	>55 mm	Scab	Rhiz.	Crack	
1	T2=31.10.19	95.7	18.7	59.6	21.7	17.0	0.0	0.0	39.0
2	T3=08.11.19	90.3	24.3	67.4	8.3	6.7	0.0	0.0	32.9
3	T1=23.10.19	97.7	18.0	63.0	19.0	31.3	0.0	0.0	30.6
4	T4=16.11.19	85.7	43.3	51.4	5.3	2.3	0.0	0.0	23.0
LSD 5%		5.50	8.70	6.67	7.01	13.02	N.S	N.S	11.32

In these studies, four different treatments were evaluated for their performance in respect of sowing dates. The highest yield was produced by T2 (39.0 t/ha) followed by the T3 which yielded 32.9 t/ha. The lowest tuber yield was produced by the T4 (23.0 t/ha). The maximum emergence (97.7%) was recorded in T1 whereas the minimum by the T4 (85.7%). Regarding Tuber grades, it was noted that T2 produced maximum ration size tubers (21.7%). Maximum percentage of small size tubers (4.3%) was produced by T4. Maximum percentage of medium size tubers was given by T3 (67.4%). Regarding scab infestation, it was observed that the maximum scab incidence (31.3%) was noted in T1 whereas minimum scab incidence (2.3%) was recorded in T4. It was observed from the experiment that the scab incidence decreased with

late sowing. All the treatments showed no impact on Rhizoctonia and tuber cracking which remained 0.0%.

3. Evaluation of potato varieties for organic farming.

Three local potato varieties were tested for two levels i.e. organic & synthetic. T1= livestock manure @ 5 ton / acre as a basal dose with no other synthetic fertilizer & pesticide and T2= Standard fertilizers & pesticides with no organic matter. The trial was planted on **07.11.2019** keeping 20cm plant to plant and 75cm row to row spacing with 6.0 m x 2.25 m plot size. The experiment was planted according to the split plot design with two treatments and three replications. The Treatments were placed in major plots whereas varieties were placed in sub plots to find out the potato varieties suitable for organic farming. Standardized agronomic practices were undertaken and necessary plant protection measures were adopted. The trial was harvested on **17.03.2020** and data regarding emergence %age, tuber grades, marketable yield and total tuber yield were recorded.

Table No.43: Performance of potato varieties in organic farming trial at PRI, Sahiwal

Treatments	Rank	Treatment	Emer. (%)	Tuber Grade (%)			Yield (t/ha)
				<35 mm	35-55mm	>55 Mm	
T1= Organic level	1	Sadaf	97.7	46.0	52.7	1.3	16.3
	2	Cosmo	94.0	16.3	73.7	10.0	22.7
	3	Sahiwal White	93.7	22.3	71.7	6.0	16.6
T2= Inorganic level	1	Sadaf	98.0	18.7	68.6	12.7	39.5
	2	Cosmo	97.3	12.7	57.0	30.3	40.1
	3	Sahiwal White	97.0	15.0	70.0	15.0	34.5
LSD 5%			9.39	8.07	18.19	18.38	11.62

It is revealed from the above table that in T1, highest yield (22.7 t/ha) was recorded by the local variety Cosmo followed by the variety Sahiwal White (16.6 t/ha). The lowest yield (16.3 t/ha) was recorded in the local variety Sadaf. In T2, the highest yield (40.1 t/ha) was recorded in Cosmo followed by the variety Sadaf which yielded 39.5 t/ha whereas the lowest yield was produced by the local variety Sahiwal White (34.5 t/ha). Keeping in view the above results, the local variety Cosmo showed its best performance in organic conditions.

B. POTATO RESEARCH STATION, SAHOWALI (SIALKOT)

1. EFFECT OF PLANT SPACING ON THE YIELD OF NEW STRAINS, SH-1650, SH-1655, SH-1658 AND SH-1662.

An experiment with six different plant spacing was laid out in order to find the most appropriate plant spacing for desirable grades and yield. The trial was carried having RCBD design with split plot design, with three replication and 2.8x6m plot size. Row and plant size, plot spacing were maintained as 75x20, 75x15, 60x20, 60x15, 50x20 and 50x15 respectively. The test lines SH-1650, SH-1655, SH-1658 and SH-1662 were sown on 29-10-2019. Fungicidal sprays were carried out to protect the crop. The standard agronomic practices were also followed for better establishment of crop stand. Yield data were recorded and analyzed statistically to find out the most suitable plant spacing for high quality tuber grades and results are presented below in Table No. 44.

Table No. 44: Effect of plant spacing

No. of varieties/lines	Treatments: Plant spacing used	Ranked plant spacing	Yield T/ha
SH-1650	T1=75X20cm	SH-1650= T2	26.43
SH-1650	T2=75x15cm	SH-1658= T1	25.88
SH-1650	T3=60x20cm	SH-1650= T1	25.73
SH-1650	T4=60x15cm	SH-1658= T2	25.47
SH-1650	T5=50x20cm	SH-1650= T3	24.85
SH-1650	T6=50x15cm	SH-1658= T3	24.35
SH-1655	T1=75x20cm	SH-1650= T4	24.16
SH-1655	T2=75x15cm	SH-1658= T4	23.33
SH-1655	T3=60x20cm	SH-1650= T5	22.97
SH-1655	T4=60x15cm	SH-1658= T5	22.76
SH-1655	T5=50x20cm	SH-1650= T6	22.52
SH-1655	T6=50x15cm	SH-1658= T6	22.14
SH-1658	T1=75x20cm	SH-1655= T2	22.09
SH-1658	T2=75x15cm	SH-1655= T1	21.00
SH-1658	T3=60x20cm	SH-1655= T3	20.48
SH-1658	T4=60x15cm	SH-1662= T1	20.29
SH-1658	T5=50x20cm	SH-1662= T2	19.73
SH-1658	T6=50x15cm	SH-1655= T4	19.61
SH-1662	T1=75x20cm	SH-1662= T3	19.23
SH-1662	T2=75x15cm	SH-1655= T5	19.20
SH-1662	T3=60x20cm	SH-1655= T6	18.68
SH-1662	T4=60x15cm	SH-1662= T4	18.11
SH-1662	T5=50x20cm	SH-1662= T5	17.23
SH-1662	T6=50x15cm	SH-1662= T6	17.03
LSD at 0.05 level			2.60

TUBER YIELD

As per statistical analysis, plant spacing with 50x15cm in T6 of a line SH-1662 turned out to be the lowest yielder with magnitude of 17.03 T/ha tuber yield. Plant spacing with T1-75x20cm of line SH-1658 ranked second in yield production of 25.88 T/ha. It was concluded that plant spacing of 75x15cm in T2 of a line SH-1650 provided the good promising result with a magnitude of 26.43 T/ha as compared to other plant spacing used in lines/varieties of SH-1655 and SH-1662

2. SURVEY OF BLACK SCURF/RHIZOCTONIA AND COMMON SCAB DISEASE INCIDENCE OF POTATO, AT DISTRICT SIALKOT AREA FOR THE YEAR 2019-20.

Table. No.45: Survey of Black Scurf

SR. NO.	FARMER'S NAME	PLACE VILL./CITY	VARIETY SOWN	SOURCE OF IRRIGATION	AREA/ ACRE	RHIZOCTONIA percentage	SCAB percentage
1	Ansar Mahmood	Talwandi Anayat Khan	kuroda	Tube well	130	15	25
2	Ahmad Mahmood	Talwandi Anayat Khan	kuroda	=	150	10	15
3	Sadaqat Ali	Talwandi Anayat Khan	kuroda	=	60	5	10
4	Nasrullah	Dawood Bajwa	kuroda	=	5	5	10
5	Saifullah	Dawood Bajwa	kuroda	=	65	10	15
6	M. Ilyas	ChakKheina	Kurada	=	5	20	15
7	Mehmood Ahmed	Talwandi AnayatKhamn	kuroda	=	30	10	10
8	M. Afzal Gujjar	Bhopal-Wala Sialkot	Kuroda	=	8	15	10
9	Muhammad Saleem	Dawood Bajwa	Kuroda	=	10	5	5
10	Wakeel Amhed	Dawood Bajwa	Kuroda	=	30	10	10
11	Arshad Subhani	Gurri Sialkot	Kuroda	=	20	5	10

12	Muhammad Saleem	Budhian	Kuroda	=	12	5	5
13	Mian Naeem	Budhian	Kuroda	=	15	5	6
14	Rana Farooq	Dawood Bajwa	Kuroda	=	10	3	5
15	Asmat Ullah	Dawood Bajwa	Kuroda	=	4	3	5
16	Rana Ghaffar	Dawood Bajwa	Kuroda	=	4	4	8
17	Shafaqat Ali Bajwa	Showni Sulehrian Sialkot	Kuroda	=	18	10	20
18	Ali Abbas Chema	BadhokeChema	Kuroda	=	15	10	5
19	Rana Irfan	Dawood Bajwa	Kuroda	=	4	5	3
20	Rana Zahid	Dawood Bajwa	Kuroda	=	6	3	2
21	Ifthar Ahmad	Budhian	Kuroda	=	5	5	5
22	FaujiFarzand Ali	Budhian	Kuroda	=	7	5	3
23	Fahid Abdullah	Dawood Bajwa	Kuroda	=	3	4	5
24	Karmat Ali	Dawood Bajwa	Kuroda	=	4	5	6
25	Gulzar Ahmad	BholairBajwa	Kuroda	=	15	10	5
26	Ghullam Ali	Sahowali	Kuroda	=	6	30	25
27	Ihsan Ali	Showni Sulehrian Sialkot	Kuroda	=	10	15	10
28	M. Rafiq	Sahowali	Kuroda	=	6	10	8
29	M. Ashraf	Dawood Bajwa	Kuroda	=	5	5	3
30	Haji Arshad	Dawood Bajwa	Kuroda	=	8	6	3

Survey was conducted during the growing season of Potato crop for the year 2019-2020 in the adjacent locality of District Sialkot. Thirty farmer's field survey report revealed the maximum disease incidence of Rhizoctonia and Common Scab diseases as 30% and 25%

respectively. Where as minimum common Scab disease incidence with a value of 2% was observed in the farmer's field. It was noticed that where the potato tubers were treated with the fungicides before sowing by the farmers, only 3% Rhizoctonia disease incidence was recorded. Use of Fungicides for seed treatment proved to be most effective in controlling the Black Scurf/Rhizoctonia disease of Potato.

3. Drought tolerance study in potato strains of SH-1650, SH-1655, SH-1658 and SH-1662.

The trial was laid out on 30-10-2019 to check the clones with drought tolerance according to split plot size of 6x2.8m. The trial was conducted with 4 varieties/lines and 3 irrigation intervals as 15, 25 and 35 days. Data regarding emergence percentage and growth was recorded. The trial was harvested on 29-03-2020 and yield data recorded is presented in Table No.46.

Table No.46: Performance of potato strains at different irrigation intervals during 2019-2020.

Sr. No	Strains/ Varieties	Irrigation intervals	Emergence %	Tuber grades (%)			Yield T/ha
				>55mm	35-55mm	< 35mm	
1	SH-1650	15days	99	19.21	63.24	17.55	27.31
		25days	100	17.98	66.02	16.50	25.74
		35days	98	21.50	60.29	18.21	24.32
2	SH-1655	15days	96	13.12	65.63	21.25	24.28
		25days	99	12.95	63.86	23.19	23.06
		35days	97	15.16	64.29	20.55	21.41
3	SH-1658	15days	100	20.17	61.89	17.94	26.64
		25days	98	18.71	59.64	21.65	24.99
		35days	99	19.35	57.55	23.10	23.52
4	SH-1662	15days	98	10.34	65.22	24.44	20.56
		25days	95	12.25	66.50	21.25	19.56
		35days	96	13.94	62.77	23.29	18.66
LSD at 0.05 level			4.76	3.29	3.14	4.13	2.34

The data presented in Table 46 showed that maximum yield of 27.31 T/ha in 15 days interval was recorded in case of a line SH-1650 followed by in an irrigation level of 15 days, 26.64 T/ha tuber yield recorded in a line of SH-1658 as compared with SH-1655 and SH-1662. In irrigation interval of 35 days, lowest tuber yield of 18.66 T/ha was observed in a line/variety SH-1662 compared with other potato strains of SH-1658, SH-1655 and SH-1650.

4. FOOD TECHNOLOGY:

A. POTATO RESEARCH INSTITUTE, SAHIWAL:

1. Screening of varieties /strains for high dry matter contents and specific gravity

Samples (potato tubers) of 11 different potato varieties were collected from the field after harvesting the crop. The specific gravity and dry matter content data were recorded with potato hydrometer. Resulted are presented below:-

Table No. 47: Performance of different strains regarding dry matter at PRI, Sahiwal

Rank	Varieties Name	Specific gravity	Dry matter %
1	Oclair	1.081	19.3
2	Frivol	1.081	19.3
3	Eldorado	1.079	18.8
4	Aurea	1.078	18.5
5	Crisper	1.077	18.2
6	White Lady	1.076	17.9
7	Ferrari	1.074	17.6
8	Basa	1.072	17.1
9	Surya	Below 1.065	Below 17%
10	Elbeida	Below 1.065	Below 17%
11	Balatoni Rozsa	Below 1.065	Below 17%

In these studies, 11 potato accessions were evaluated for dry matter contents /specific gravity. The exotic varieties Oclair & Frivol remained at the top in this respect with 19.3% dry matter contents and 1.081 specific gravity each followed by the exotic variety Eldorado which showed 18.8% dry matter contents and 1.079 specific gravity. Three exotic potato varieties viz: Surya, Elbeida & Balatoni Rozsa showed dry matter contents below 17% and below 1.065 specific gravity.