ANNUAL TECHNICAL REPORT

FOR THE YEAR

2019-2020

PLANT PATHOLOGY RESEARCH INSTITUTE, FAISALABAD.

ANNUAL REPORT OF PLANT PATHOLOGY SECTION, PLANT PATHOLOGY RESEARCH, INSTITUTE, FAISALABAD FOR THE YEAR, 2019-2020.

INTRODUCTION:

The report covers research work done at Plant Pathology Research Institute, Faisalabad, during the year, 2019-2020. The Institute comprises on Plant Pathology section , Plant Virology section and Pest Control Training Division.

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OBJECTIVES:`

1. Identification of plant diseases caused by various pathogens and their suitable control measures.
2. Collaboration with the breeders of all crops and vegetables in evolving the disease resistant varieties of the crops and vegetables.
3. Testing the efficacy of new commercial fungicides against plant diseases.
4. Identification of cultural and biological means of disease control measures.
5. Studies on the seed borne myco-flora of different crops and vegetables and to find out the appropriate chemical control measures.
6. Studies on *Phytophthora* spp. infecting different crops, vegetables and fruit plants in the Punjab.
7. Identification of new diseases of field crops, vegetables and fruit plants and developing their management strategies.
8. Transfer of disease management technology to Agri. Extension Staff and farmers through electronic and print media.
9. Survey, identification and study on viral diseases of cotton, vegetables, pulses and horticultural plants.
10. Continuous monitoring of vector appearance.
11. Screening of plant material against different viruses.
12. Elimination of potato viruses through tissue culture and roughing practices.
13. Production of pre-basic certified seed potato.
14. Characterization environmental conditions conducive to Potato viral diseases development.
15. Investigate the role of different plant hormones in meristem culture of potato.
16. Motivate and trained the new potato growers.
17. Impart trainings about tissue culture technology to the Agri. Ext. and students from different universities.
18. Dissemination of technology through electronic and print media.
19. To impart general and specialized training in the latest methods of pest control to the employees of the agriculture department.
20. To familiarize the farmers with the recent developments in plant protection science I.E intergraded pest control measures.
21. To acquaint the farmers with judicious use of pesticides.

FOCUS ON RESEARCH

1. Screening for disease resistance
2. Decline of Fruit plants
3. Biological control
4. Management of plant diseases cause by fungi, Bacteria & nematodes
5. Seed pathology
6. Production of pre-basic certified seed potato.

7. To impart general and specialized training in the latest methods of pest control to the employees of the agriculture department.

RESEARCH WORK DONE DURING, 2019-20

1. EVALUATION OF WHEAT VARIETIES/ LINES AGAINST LOOSE SMUT (*Ustilago tritici*)

During 2018-2019 fourty lines/varieties of Wheat comprising of advanced lines received from Wheat Research Institute, Faisalabad were sown to determine their performance against loose smut disease caused by *U. stilago tritici*. Two lines each measuring 2 meters in length and 30 cm apart were sown under each entry. The crop was sown on 15.11.2019 and normal agronomic practices were adopted. The weather conditions, i.e. temperature and rainfall etc remained favorable to crop growth. The observations on the incidence of loose smut were recorded at panicle emergence using Illyas et al., 2009. To determine their performance against disease WL711 was sown as check variety.

EVALUATION OF WHEAT VARIETIES/ LINES AGAINST LOOSE SMUT (*U. tritici*)

Disease incidence (%)	Reaction	No. Of Varieties/ Lines	Varieties/Lines
0	I	-	-
1 – 5	HR	-	-
6 – 10	R	10	14124, 15166, 15235, 15309, 16005, HYT20-19, Sehar, Anaj-17, 17C090, 162393
11 – 20	MR	10	HYT60-5, 16159, 17151, 17177, 17182, NA-85, MILLAT-11, FSD-8, 17C089,16282
21 – 30	MS	10	HYT6057, 165024, 16150, 16157, 17164,17157, 17174, 17183, ASS-11, 17151
31 – 50	S	8	16120, 16163, 17154, WL711, 17179, PUNJAB-11, AARI-11, 17180
51-100	HS	2	HYT-53-33, 17177
	Total:	40	

2. EVALUATION OF SUGARCANE GERMPLASM AGAINST RED ROT (*Colletotrichum falcatum*)

Fourteen varieties/lines of sugarcane were sown on 13.09.2019 in the research area of Sugarcane Research Institute, Faisalabad to determine their performance against Red Rot disease caused by *C. falcatum*. All agronomic practices were adopted. The plants were inoculated in the month of August 2015 with *C. falcatum* culture. The data were recorded and the reaction of the varieties/lines was evaluated according to Srinivasan and Bhatt (1961) scale. The data revealed that there was a significant variation in disease response in all the cultivars, ranging from susceptible to resistant response.

EVALUATION OF SUGARCANE GERMPLASM AGAINST RED ROT (*C. falcatum*)

Scale	Disease severity (%)	Reaction	No. Of Varieties / Lines	Varieties/Lines
1	1-10	R	6	06-US S-54, M-42, CO-238, FD-18, 02-US-133, 06SPF302
2	11-20	MR	3	03-US633, 09SA 111, SA-08
3	21-50	MS	0	-
4	51-60	S	3	03US778, S2006-SP-93, VMC87/599
5	6.1 & above	HS	2	C1148, S2003-US-272
		Total:	14	

3. EVALUATION OF SUGARCANE GERMPLASM AGAINST WHIP SMUT (*Ustilago scitaminea*)

Twelve varieties/lines of sugarcane were sown in the month of September in the research area of Sugarcane Research Institute, Faisalabad to determine their performance against whip smut disease caused by *U. scitaminea*. All agronomic practices were adopted. The sets of sixteen sugarcane varieties/lines were inoculated artificially with fresh spore suspension of the pathogen before sowing. The data were recorded according to Shuktal et al., 1989 scale. The data revealed that there was a significant variation in disease response in all the cultivars, ranging from susceptible to resistant

EVALUATION OF SUGARCANE GERMPLASM AGAINST WHIP SMUT (*U. scitaminea*)

Sr. No.	Disease (%)	Reaction	No. Of Varieties / Lines	Varieties/Lines

1	0 – 5	R	7	06-US554, 03-US633, CO238, 06SP-93, 09SA111, 02-US-133, VMC-87/599
2	5.1 – 15	MR	2	M-42, SA-08
3	15.1 – 30	MS	1	FD-18
4	30.1 – 50	S	2	03US-778, 96SPF-302
5	50.1 & above	HS	-	-
Total:			12	

4. **EVALUATION OF MASH GERMPLASM AGAINST COLLAR ROT DISEASE**

Fifteen varieties/lines of mash bean were taken from Pulses Research Institutes, Faisalabad and were evaluated against collar rot disease under field conditions. The experiment was conducted in experimental area of Plant Pathology Section, Plant Pathology Research Institute, Faisalabad. Trial was sown in augmented design on August 5, 2019. Data was recorded by following Mayee and Datar (1986) scale. Out of fifteen varieties/lines, no one variety/line was found immune against collar rot disease. Three varieties/lines (ES-1, Mash SPN-1 & Mash SPN-2) were found to be highly resistant and 16M003, 62027 & 6036-21 were found resistant. Four varieties/lines 18M007, 17M006, 17M010 & 16M008 were evaluated as moderately resistant against the disease. 16M005, 16M010 & 4CM-716 exhibited susceptible response against the disease whereas 18M003 & Mash-97 were highly susceptible against the collar rot disease.

Reaction of mash germplasm to collar rot disease according to Mayee and Datar (1986) scale

Disease %	**Reaction**	**Varieties/line**	**No. of varieties/line**
0%*	Immune	None	-
1 or less	Highly resistant	ES-1, Mash SPN-1, Mash SPN-2	03
1-10%	Resistant	16M003, 62027, 6036-21	03
11-20%	Moderately resistant	18M007, 17M006, 17M010, 16M008,	04
21-50%	Susceptible	16M005, 16M010, 4CM-716	03
51% or more	Highly susceptible	18M003, Mash-97,	02
		Total	15
*Reaction based on percent plant mortality			

5. RESPONSE OF DIFFERENT COTTON VARIETIES/LINES AGAINST BACTERIAL BLIGHT OF COTTON DISEASE.

Twenty-six varieties/lines of cotton were taken from Cotton Research Institutes, Faisalabad and were evaluated against bacterial blight (*X. campestris* pv. *malvacearum*) under field conditions. The experiment was conducted in experimental area of Plant Pathology Section, Plant Pathology Research Institute, Faisalabad. Trial was sown in augmented design keeping row to row and plant to plant distance 75 cm and 30 cm respectively. Data was recorded by following Birkerhoff**,** (1977) scale. Out of thirty-one cotton varieties/lines, no one variety/line was found immune and highly resistant against bacterial blight disease. Three varieties/lines viz. FH-142, FH-152 and FH-326 exhibited resistant response against the disease. Only FH-478 was found moderately resistant against the pathogen's virulence. Ten varieties/lines (FH-498, FH-494, FH-466, FH-313, FH-412, FH-Lalazar, FH-Super cotton, FH-312 & FH-450) responded as moderately susceptible while FH-490, FH-442, FH-444, FH-6071, FH-Anmol, FH-425, FH-315, FH-474, FH-942, FH-118, FH-114, FH-318 and FH-457 were ranked as susceptible against the bacterial blight of cotton disease.

Response of different varieties/lines against bacterial blight of cotton disease.

Name of Varieties	Response	Frequency
FH-142, FH-152, FH-326	Resistant	3
FH-478	Moderately Resistant	1
FH-498, FH-494, FH-466, FH-313, FH-412, FH-Lalazar, FH-Super cotton, FH-312, FH-450	Moderately Susceptible	9
FH-490, FH-442, FH-444, FH-6071, FH-Anmol, FH-425, FH-315, FH-474, FH-942, FH-118, FH-114, FH-318, FH-457	Susceptible	13

6. REACTION OF MUNGBEAN GERMPLASM TO COLLAR ROT DISEASE

Fifteen varieties/lines of mung bean were taken from Pulses Research Institutes, Faisalabad and were evaluated against collar rot disease under field conditions. The experiment was conducted in experimental area of Plant Pathology Section, Plant Pathology Research Institute, Faisalabad. Trial was sown in augmented design on August 5, 2019. Data was recorded by following Mayee and Datar (1986) scale. Out of fifteen varieties/lines, no one

variety/line was found immune against collar rot disease. Two varieties/lines (E-28-1 & V1059228) were found to be highly resistant and NM-54, L X No-10-71, 8009 & NM-98 were found resistant. Two varieties/lines i.e. NM-28 & NIFA-5 were evaluated as moderately resistant against the disease. TM-1426, L X No-303, BRNM-14 & NM-12 exhibited susceptible response against the disease whereas TM-1428, L X No-107 and L X No-77 were highly susceptible against the collar rot disease.

REACTION OF MUNGBEAN GERMPLASM TO COLLAR ROT DISEASE

Reaction	**Varieties/line**	**No. of varieties/line**
Immune	None	-
Highly Resistant	E-28-1, V1059228	02
Resistant	NM-54, L X No-10-71, 8009, NM-98	04
Moderately Resistant	NM-28, NIFA-5	02
Susceptible	TM-1426, L X No-303, BRNM-14, NM-12	04
Highly susceptible	TM-1428, L X No-107, L X No-77	03
Total		15

7. EVALUATION OF MAIZE GERMPLASM AGAINST STALK ROT (*Fusarium moniliforme*)DISEASE

Twelve varieties/lines supplied by the Maize & millet research Institute, Yousafwala, Sahiwal were screened against stalk rot pathogen in the research area of Plant Pathology Section, PPRI, Faisalabad. Each variety/ line was sown in 4 rows of 4m long. After 45 days twenty five plants of each variety/ line were inoculated with the pure culture of *F. moniliforme*, the causal organism of stalk rot of maize. After 60 days of inoculation the disease data was recorded by using the Meena Shekhar (2012) rating scale

EVALUATION OF MAIZE GERMPLASM AGAINST STALK ROT (*F. moniliforme*) DISEASE

Disease rating	Infection (%)	Reaction	No. of Varieties / lines	Varieties/lines
1	0.1-20	R	-	-
2	20.1-50	MR	2	YHP-33, YHP-37
3	50.1-75.0	MS	7	YH5427, YH P-29, YH P-43, YH P-44, Malka, YH-P-30 & YH P-46

4	75.1 & above	S	3	YH5569, YH5532, FH-929
Total			12	

8. SCREENING OF RICE LINES/VARIETIES AGAINST SHEATH BLIGHT (*Rhizoctonia solani*)

Twenty two varieties / lines supplied by the Rice Research Institute, Kala Shah Kaku and Nuclear Institute for Agriculture and Biology, Faisalabad were sown in last week of June, 2019 and then transplanted in 3rd week of July 2019 in sick field at Plant Pathology Research Institute, Faisalabad to determine their performance against Sheath Blight disease caused by *R. solani*. Check varieties was also sown in between the test line. All agronomic practices were adopted. Data were recorded on the basis of plant mortality by using Standard Evaluation System for Rice -IRRI.

EVALUATION OF RICE VARIETIES/LINES AGAINST *R. solani*

Disease Incidence (%)	**Reaction**	**No. of varieties/ Lines**	**Name of varieties/lines**
1.1 – 10.0	R	-	-
10.1– 20.0	MR	6	Kissan Basmati, Super Basmati, PK-1121, Punjab Basmati,ST-9, Gc-75
20.1–50.0	MS	13	Rc-195, P-35, S2-5, EFLD, S39, Gc- 50, Chenab Basmati, Bas- 515, KSK-133, IR-6, Pk-386, KSK 434, P-47
50.1–70.0	S	3	P-48, NB- 1827, KSK282
70.1 and above.	H.S	0	-
	Total:	22	

9. SCREENING OF SESAME GERMPLASM AGAINST STEM ROT.

Fifteen lines/ varieties of sesame received from Oilseed Research Institute, Faisalabad and NIAB, Faisalabad were sown to determine their performance against Stem Blight disease. Two lines each measuring 2.5 fit in length and 25 cm apart were sown under each entry. The crop was sown on 18.06.2019 and normal agronomic practices were adopted. The data on the basis of plant mortality was recorded by using G.S. Saharan and Naresh Mehta 2008 (1-6) scale.

SCREENING OF SESAME GERMPLASM AGAINST STEM ROT.

Disease %	Reaction	Varieties/line	No. of Varieties/line
1% or less	Highly Resistant	-	-
1-10 %	Resistant		
11-20 %	Moderately resistant	NS (103-1), NS260 SP-2, 16002, 70005, TH-6, NS-786, NS-260-SP-4	7
21-30 %	Moderately Susceptible	50022, Black TILL, ML-6-8, NS-2016, TIL-89	5
31-50 %	Susceptible	86003, TS-3, TS-5	3
51 % or more	Highly Susceptible		
Total			15
*Reaction based on percent plant mortality			

10. IMPACT OF SOWING DATES ON EPIDEMIOLOGY OF STEM ROT OF SESAME

Four different times were studies for the sowing of the crop starting from mid-June to end- July with fortnight interval, to find the most suitable time to escape the disease. Varieties TS-5 was sown on 18-06-2019, 02-07-2019, 17-07-2019 & 31-07-2019. Five lines, each line representing a replication for each treatment i.e. time of sowing were sown on 3m X 45cm bed. The data on the basis of plant mortality (%) was recorded which is given in the table.

IMPACT OF SOWING DATES ON EPIDEMIOLOGY OF STEM ROT OF SESAME

Sr. No.	Treatments (Date of sowing)	Disease severity (%)					Mortality (%) age
		R1	R2	R3	R4	R5	
1.	18-06-2019	35.0	37.5	42.5	42.5	40.0	39.5
2.	02-07-2019	30.0	25.0	25.0	22.5	32.5	27.0
3.	17-07-2019	22.5	15.0	15.0	12.5	12.5	15.5
4.	31-07-2019	35.0	40.0	37.5	30.0	35.0	35.5

Mid July is the best time to escape the disease as befor and after this sowing date percentage of plant mortality increased.

11. EVALUATION OF PEA GERMPLASM AGAINST COLLAR ROT DISEASE UNDER FIELD CONDITIONS.

Seventeen varieties/lines of pea were taken from Vegetable Research Institutes, Faisalabad and were evaluated against collar rot disease under field conditions. The experiment was conducted in experimental area of Plant Pathology Section, Plant Pathology Research Institute, Faisalabad. Trial was sown in augmented design. Data were recorded by following Mayee and Datar (1986) scale. Out of seventeen varieties/lines, no one

variety/line was found immune against collar rot disease. Two lines (1300-8 & No. 267) were found to be highly resistant and Pea-09, Sarsabaz, 2001-20 and Samrina Zard were found resistant. Five varieties/lines Lina Pak, Super Lina, Green cross, PF-402 and Oskar were evaluated as moderately resistant against the disease. 9200-1, 9800-5, Climax, and Classic exhibited susceptible response against the disease whereas 9374 and 9375 were highly susceptible against the collar rot disease.

Disease %	**Reaction**	**Varieties/line**	**No. of Varieties/line**
0%*	Immune	None	-
1 or less	Highly resistant	1300-8, No. 267	02
1-10 %	Resistant	Pea-09, Sarsabaz, 2001-20, Samrina Zard	04
11-20 %	Moderately resistant	Lina Pak, Super Lina, Green cross, PF-402, Oskar	05
21-50 %	Susceptible	9200-1, 9800-5, Climax, Classic	04
51 % or more	Highly susceptible	9374, 9375	02
Total			17

12. EVALUATION OF GRAM GERMPLASM AGAINST STEM ROT (*Sclerotinia minor*).

Fifty one lines/ varieties of gram received from Pulses Research Institute, Faisalabad and Arid zone Research Institute, Bhakker were sown to determine their reaction against Stem rot disease. One lines each measuring 4.0 meter with line to line 60cm and plant to plant 45 cm were sown under each entry. The crop was sown on 01.11.2019 in sick field. The data on the basis of plant mortality was recorded by using G.S. Saharan and Naresh Mehta 2008 (1-6) scale.

EVALUATION OF GRAM GERMPLASM AGAINST STEM ROT (*S. minor*).

Disease Severity index (%)	Reaction	No. of Varieties/lines	Varieties/lines
No. Disease	I	-	-
<1 Tiller Mortality	R	6	TG-1621, TG-1419, TG-1410, TG-1618, TG-1430, TG-1626
1-10 Tiller Mortality	MR	31	TG-1616, NOOR-2013, TG-1617, TG-1401, BITTLE-2016, TG-1215, TG-1429, TG-1419, TG-1426, TG-1305, TG-1430, TG-125K10, TG-1425, TG-1415, TG-12K02, TG-1309, 09AG006, TG-1429, TG-1423, TG-1424, TG-1618, TG-1614, TG-1613, TG-1401, TGX220, TG-1420, BKK02174, TG-1427, TGX228, TG-1218, TG12K01

11-25 Tiller Mortality	MS	11	BHAKKAR-2011, TG-1615, TG-1613, TG-1620, TG-1623, TG-1415, TG-1410, TG-1424, NOOR-2009, TG-1617, TG-1622
26-50 Tiller Mortality	S	3	TG-1619, TG-12K07, CM-2006
>50 Tiller Mortality	HS	-	-
Total:-		51	

13. EVALUATION OF PEAS GERMPLASM AGAINST POWDERY MILDEW (*Erysiphe polygoni*)

Ten varieties/lines of peas were received from Vegetable Research Institute, Faisalabad. The varieties/lines were sown on 05-11-2019 along with susceptible variety in the research area Plant Pathology Research Institute Faisalabad to determine their performance against powdery mildew disease caused by *E. polygoni*. The entries were planted in four blocks each having two check varieties randomized in the test entries. All agronomic practices were adopted. Diseased samples were collected. Varieties/lines were artificially inoculated with the fresh inoculum. The disease incidence and intensity data were recorded by using Jayaraj and Pakja, 2007 scale. The data revealed that there was a significant variation in disease response in all the varieties / lines, ranging from susceptible to resistant response.

EVALUATION OF PEAS GERMPLASM AGAINST POWDERY MILDEW (*E. polygoni*)

Disease Severity (%)	Reaction	No. of varieties / Lines	Varieties/ Lines
0- No symptom	Immune	-	-
1- Small powdery mildew spots (up to 5mm in size) covering 1% of the area.	Highly resistant	1	92001
3- Small powdery lesions covering 1-10% of the leaf.	Resistant	6	1300-8, Pea-09, Lina Pak, Green Gross, Sarsabz, Classic
5- Powdery enlarging irregular covering 11-25% the leaf	Moderately resistant	-	-

7- Powdery mildew lesions coalescing, forming big patches. Cover 26-50% of the leaf area. Lesions also produced on pods and tendrils	Moderately susceptible	2	2001-20, V-9374,
9- Powdery patches cover 51% or more of the leaf area. Symptoms on pods and tendrils.	Susceptible	1	9800-5
Total:		10	

14. EVALUATION OF ONION GERMPLASM AGAINST STEMPHYLIUM BLIGHT OF ONION CAUSED BY *S. botryosum*

Fifteen varieties/lines of Onion were received from Vegetable Research Institute, Faisalabad. The varieties/lines were sown on 16-12-2019 along with susceptible variety in the research area Plant Pathology Research Institute Faisalabad to determine their performance against Stemphylium blight disease caused by *S.botryosum*. The entries were planted in two blocks each having one check varieties randomized in the test entries. All agronomic practices were adopted. Diseased samples were collected. Varieties/lines were artificially inoculated with the fresh inoculum. The disease incidence and intensity data were recorded by using Sharma,1986 scale. The data revealed that there was significant variation in disease response in all the cultivars, ranging from susceptible to resistant.

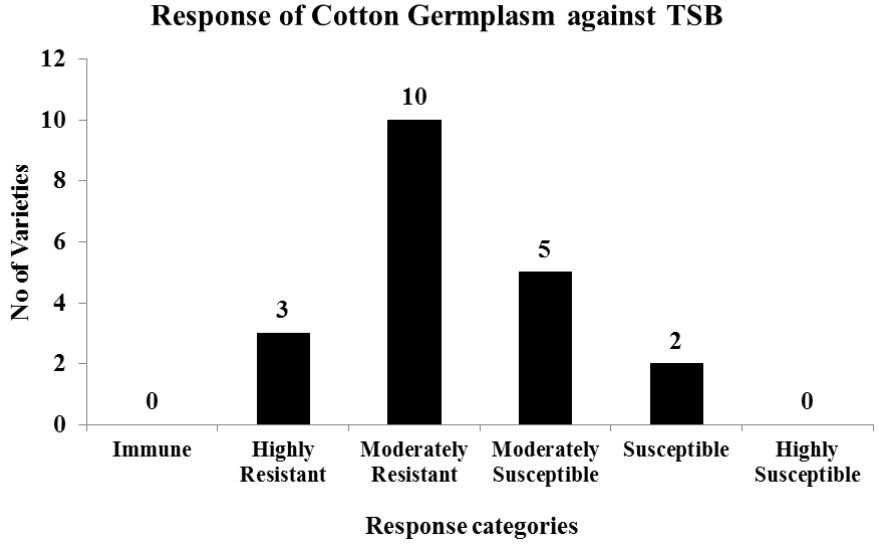
EVALUATION OF ONION GERMPLASM AGAINST STEMPHYLIUM BLIGHT OF ONION CAUSED BY *S. BOTRYOSUM*

Sr. No.	Intensity	Reaction	Verities reaction	No. of Varieties/ lines
0	0-0	Immune	-	-
1	1-10	Resistant	-	-
3	11-25	Moderately Resistant	NR-1, VRIO-07, VRIO-08, ON-1215, TARZAN, HON-300A, RANIA	7

5	26-50	Moderately Susceptible	VRIO-2, VRIO-05, VRIO-06, VRIO-09, ND-96, RED IMPOSTA, HON-304	7
7	51-75	Susceptible	VRIO-4	1
9	76-100	Highly Susceptible	-	-
Total				15

15. EVALUATION OF COTTON GERMPLASM AGAINST TWIG AND STEM BLIGHT

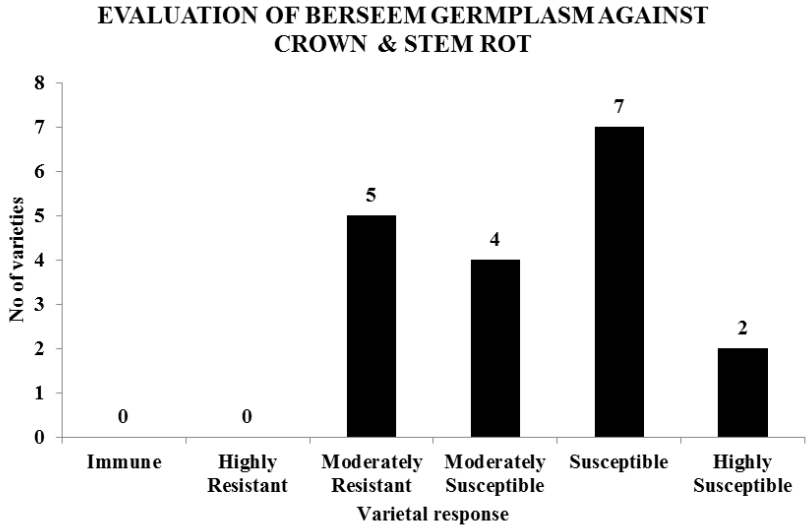
The experiment was conducted on 12-04-2019 in the research area of Plant Pathology Research Institute, Faisalabad. A total of 20 germplasm lines/varieties were tested against twig and stem.The experiment was laid out in completely randomized block design with four replications. Inoculum was prepared and sprayed at 4 week stage. Disease severity data was recorded and the results are given below in Fig ii.



16.* EVALUATION OF BERSEEM GERMPLASM AGAINST STEM AND CROWN ROT *Sclerotinia trifoliorum

A total of 18 germplasm lines/varieties were tested against stem and crown rot on 15-11-2019 in sick field where mass culture of the pathogen (100 sclerotia per 10 m^2) added in the soil.

Disease severity data was recorded at each cutting.



17. EVALUATION OF TOMATO GERMPLASM AGAINST BACTERIAL WILT

The advance germplasm (7 varieties) was collected from Vegetables Research Institute, Faisalabad. Seedling roots were treated with fresh culture suspension of pathogen (*Ralstonia solanacearum*) before transplant into pots. Each entry was transplanted in 3 replications and with one control. Data was recorded on plant mortality basis after the appearance of the disease. Out of 7 lines 3 (Sahel F1, Salar F1 and Sundar F1) were found moderately resistant while 4 lines (Sagar F1, Red rocks F1, ANNA F1 and Ilmar F1) were found moderately susceptible.

Rating	Bacterial wilt incidence (%)	Lines/ Varieties
0	Highly resistant with no wilt symptom	-
1	Resistant with 1 -10% wilted plants	-
2	Moderately resistant with 11 -20% wilted plants	Sahel F1, Salar F1 and Sundar F1
3	Moderately susceptible, with 21-30% wilted plants	Sagar F1, Red rocks F1, ANNA F1 and Ilmar F1
4	Susceptible with 31- 40% wilted plants	-
5	Highly susceptible with > 40% wilted plants	-

18. EVALUATION OF UNDETERMINATE TOMATO GERMPLASM AGAINST DISEASES.

Fifteen varieties/lines of tomato were sown on 27-11-2019 in tunnel of PPRI, Faisalabad to determine their performance against wilt disease caused by *Fusarium oxysporum*. All agronomic practices were adopted. The data on plant mortality basis was

recorded. The data revealed that there was significant variation in disease response in all the cultivars, ranging from susceptible to resistant.

SCREENING OF TOMATO GERMPLASM AGAINST EARLY BLIGHT (TUNNEL)

GARADE	NATARE OF INFECTION	LEVEL OF RESISTANCE/ SUSCEPTIBITY	NAME OF GERMPLASM	NO. OF ENTRIES
0	No Symptoms on Leaf	Immune	-	-
1	Small irregular Brown spot covering 1% of less leaf area	Resistant	LITTH-907	1
3	Small irregular brown spot with concentric rings covering 1-10% leaf area	Moderately Resistant	LITTH-903, SANDAL, LITTH-936, LITTH-940, LITTH-944, LITTH-946, LITTH-904	7
5	Lesion enlarge irregular, Brown with concentric rings covering 11-25% of leaf area	Moderately Susceptible	LITTH-922, LITTH-927, ANNA, LITTH-942, SAHAL, LITTH-861, LITTH-908	7
7	Lesions coalesce to from irregular brown patch with concentric rings covering 26-50% of leaf area lesion also on stem and petioles.	Susceptible	-	-
9	Lesion coalesce to form irregular brown patches with concentric rings covering 51% or more leaf area. Lesions on stem and petiols	Highly Susceptible	-	-
			Total	15

SCREENING OF TOMATO GERMPLASM AGAINST LATE BLIGHT (TUNNEL)

GARADE	NATARE OF INFECTION	LEVEL OF RESISTANCE/ SUSCEPTIBITY	NAME OF HYBRIDS	Total
0	No symptoms on leaf	Immune	-	-

1	Only a few plants affected here and there up to 10 spats per plant or general light spotting	Resistant	LITTH-903, LITTH-946	2
3	About 50 spots per plants or up to 1 leaf lets in 10 attacked	Moderately Resistant	LITTH-907, LITTH-944, LITTH-922, Sahel F^1, Sandal F^1, LITTH-904, LITTH-936	7
5	Nearly every leaf with spot plants still retaining normal for field may smell of blight but look green although every plant is affected.	Moderately Susceptible	LITTH-908, LITTH-940, LITTH-861, LITTH-927, LITTH-942, Anna F^1	6
7	Every plant affected and about ½ of leaf area destroyed by blight field look green fleeted with brown	Susceptible	-	-
9	About ¾ of leaf were destroyed by blight field looks either predominantly brown or green only a few leaves lets green. All leaves dead, stem dead or drying	Highly Susceptible	-	-
			Total	15

SCREENING OF TOMATO GERMPLASM AGAINST GREY MOLD (TUNNEL)

GRADE	NATARE OF INFECTION	LEVEL OF RESISTANCE/ SUSCEPTIBITY	NAME OF GERMPLASM	No. of Enters
1	No symptoms.	Highly Resistant	-	-
2	Necrosis present on 1-2 leaves and Limited superficial lesions on the stem.	Resistant	LITTH-903, LITTH-907	2
3	Necrosis present on 10% of the foliage and Lesion expanding to 10 mm diameter with limited sporulation.	Moderately Resistant	SAANDAL F1, LITTH-927, LITTH-944, LITTH-946, LITTH-904	5

4	Necrosis present on 20% of the foliage and Lesions expanding to 40 mm diameter, depressed with sporulation.	Susceptible	LITTH-940, ANNA F1, LITTH-861, LITTH-942, SAHEL F1	5
5	Necrosis present on greater than 20% of the foliage and Lesions expanding to greater than 40 mm diameter, depressed with sporulation or stems completely girdled.	Highly Susceptible	LITTH-908, LITTH-936, LITTH-861	3
			Total	15

SCREENING OF TOMATO GERMPLASM AGAINST *FUSARIUM* WILT (TUNNEL)

GARADE	NATARE OF INFECTION	LEVEL OF RESISTANCE/ SUSCEPTIBITY	NAME OF GERMPLASM	NO. OF ENTRIES
0	No. symptoms on any plant	Highly Resistant	-	-
1	Less 1% witted plants	Resistant	LITTH-907, SANDAL F1, ANNA F1, LITTH-946	4
3	1-10% wilted plants	Moderately Resistant	LITTH-903, LITTH-922, LITTH-940, LITTH-861, LITTH-904	5
5	11-20% wilted plants	Moderately Susceptible	LITTH-908, LITTH-942, LITTH-936, LITTH-927	4
7	21-50% wilted plants	Susceptible	LITTH-944, SAHEL F1	2
9	51% and above wilted plants	Highly Susceptible	-	-
			Total	15

19. EVALUATION OF DETERMINATE TOMATO GERMPLASM AGAINST DISEASES.

Twenty six varieties/lines of tomato were sown on 16-12-2019 in open field of PPRI, Faisalabad to determine their performance against wilt disease caused by *Fusarium oxysporum*. All agronomic practices were adopted. The data revealed that there was significant variation in disease response in all the cultivars, ranging from susceptible to resistant.

SCREENING OF TOMATO GERMPLASM AGAINST LATE BLIGHT (FIELD)

GARADE	NATARE OF INFECTION	LEVEL OF RESISTANCE/ SUSCEPTIBITY	NAME OF GERMPLASM	NO. OF ENTRIES
0	No symptoms on leaf	Immune	-	-
1	Only a few plants affected here and there up to 10 spats per plant or general light spotting	Resistant	LTH-503, LTH-515, 18277, LTH-422, NAQEEB, 10142, 174256	7
3	About 50 spots per plants or up to 1 leaf lets in 10 attacked	Moderately Resistant	LTH-492, AHMAR, 13234, LTH-514, LTH-459, NADIR, LTH-520, 10139, LTH-421, 17261	10
5	Nearly every leaf with spot plants still retaining normal for field may smell of blight but look green although every plant is affected.	Moderately Susceptible	LTH-324, 18282, LTH-466, 18273, TO1057 F1, 18273, 17257, RIO GRANDI	7
7	Every plant affected and about ½ of leaf area destroyed by blight field look green fleeted with brown	Susceptible	LTH-459, LTH-506	2
9	About ¾ of leaf were destroyed by blight field looks either predominantly brown or green only a few leaves lets green. All leaves dead, stem dead or drying	Highly Susceptible	-	-
			Total	**26**

SCREENING OF TOMATO GERMPLASM AGAINST GREY MOLD (FIELD)

GARADE	NATARE OF INFECTION	LEVEL OF RESISTANCE/ SUSCEPTIBITY	NAME OF GERMPLASM	NO. OF ENTRIES
1	No symptoms.	Highly Resistant	-	-

2	Necrosis present on 1- 2 leaves and Limited superficial lesions on the stem.	Resistant	NAQEEB, 17256, 13234, 10139, 17257	5
3	Necrosis present on 10% of the foliage and Lesion expanding to 10 mm diameter with limited sporulation.	Moderately Resistant	LTH-492, LTH-503, LTH-514, AHMAR HYBRIDS, LTH-459, LTH-421, LTH-515, LTH-422, 18282, 18277, 18273, NADIR, RIO GRANDI	12
4	Necrosis present on 20% of the foliage and Lesions expanding to 40 mm diameter, depressed with sporulation.	Susceptible	LTH-466, LTH-520, TO1057 FI, LTH-506, LTH-459, 10142, 17261	7
5	Necrosis present on greater than 20% of the foliage and Lesions expanding to greater than 40 mm diameter, depressed with sporulation or stems completely girdled.	Highly Susceptible	LTH-324	1
			Total	26

SCREENING OF TOMATO GERMPLASM AGAINST EARLY BLIGHT (FIELD)

GARADE	NATARE OF INFECTION	LEVEL OF RESISTANCE/ SUSCEPTIBITY	NAME OF GERMPLASM	NO. OF ENTRIES
0	No Symptoms on Leaf	Immune	-	-
1	Small irregular Brown spot covering 1% of less leaf area	Resistant	LTH-503, LTH-422, 17257, 13234, 17256, 18282, 18277, NAQEEB, 18273, 10139	10
3	Small irregular brown spot with concentric rings	Moderately Resistant	LTH-492, LTH-324, LTH-514, AHMAD HYBRIDS, LTH-520,	12

	covering 1-10% leaf area		LTH-506, LTH-421, LTH-515, RIOGRANDI, 10142, 17261, NADIR	
5	Lesion enlarge irregular, Brown with concentric rings covering 11-25% of leaf area	Moderately Susceptible	LTH-459, LTH-466, LTH-459	3
7	Lesions coalesce to from irregular brown patch with concentric rings covering 26-50% of leaf area lesion also on stem and petioles.	Susceptible	TO1057 F1	1
9	Lesion coalesce to form irregular brown patches with concentric rings covering 51% or more leaf area. Lesions on stem and petiols	Highly Susceptible	-	-
			Total	26

SCREENING OF TOMATO GERMPLASM AGAINST *FUSARIUM* WILT (FIELD)

GARADE	**NATARE OF INFECTION**	**LEVEL OF RESISTANCE/ SUSCEPTIBITY**	**NAME OF GERMPLASM**	**Total**
0	No. symptoms on any plant	Highly Resistant	-	-
1	Less 1% witted plants	Resistant	LTH-492, LTH-514, 10139, NADIR, 18282, NAQEEEB, 18277	7
3	1-10% wilted plants	Moderately Resistant	LTH-324, LTH-503, LTH-459, LTH-466, LTH-520, LTH-506, LTH-421, LTH-459, LTH-422, 13234, 17256, 18273	12
5	11-20% wilted plants	Moderately Susceptible	TO1057, 17257, 10142, 18277	4
7	21-50% wilted plants	Susceptible	LTH-515	1
9	51% and above wilted plants	Highly Susceptible	RIO GRANDI, 17261	2
			Total	26

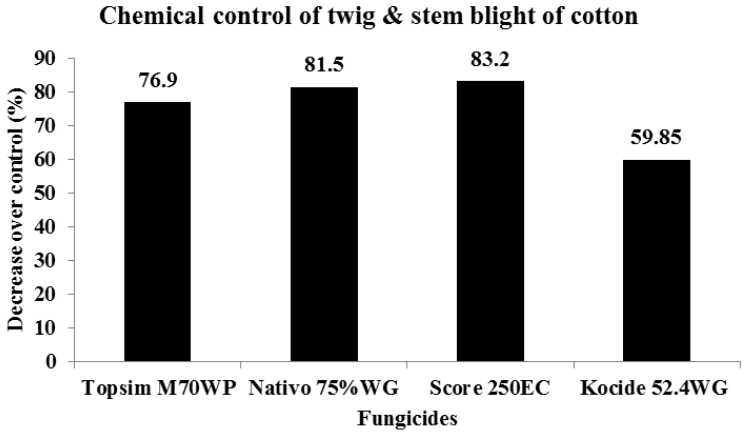
20. CHEMICAL CONTROL OF STEM & TWIG BLIGHT OF COTTON

To evaluate different chemicals for the control of twig & stem blight, experiment was conducted on 12-04-2019 in the research area of Plant Pathology Research Institute, Faisalabad. The experiment was laid out in randomized completely block design (RCBD) with four replications.

Treatments:-

T1= Topsin- M 70 WP (Thiophanate methyle) @ 2 gm/lit of water
T2= Nativo 75% WG (Tebuconazole + trifloxystrobin) 1g//lit of water
T3= Score 250EC (Difenoconizole) @ 1cc/lit of water
T4= Kocide 3000 52.4 WG (copper hydroxide) @ 2.5 g/lit of water
T5= Control

Disease was artificially produced by spraying spore suspension on crop. Disease data was recorded before and after fungicides application. Score 250 EC produced best results as shown in graph.



Evaluation of different chemicals against twig & stem blight of cotton

21. EFFICACY OF DIFFERENT FUNGICIDES AGAINST COLLAR ROT OF MUSKMELON

Seeds of T-96 line were taken from Vegetable Research Institute, Faisalabad. Experiment was conducted in experimental area of Plant Pathology Section. Efficacy of five different chemicals (Ridomil Gold 72 WP@ 2.5 g/L, Revus 250 SC@ 2.4 ml/L, Success 72 WP @ 2.5 g/L, Aliette @ 1g/L, Nanok 25% SC @ 2.5 ml/L) were evaluated against the collar rot disease under the field conditions. In control, nothing was applied. All agronomic practices were followed. Trial was sown in Randomized Complete Block Design with three repeats. Disease incidence (%) data were recorded after 10 days of the treatments application. Among five chemicals, Ridomil Gold 72 WP was found most effective against the collar rot disease as compared to the other chemicals. Success 72 WP was found least effective to manage the disease but was effective when compared to the control where nothing was applied. In control treatment, maximum disease incidence was recorded.

Efficacy of different fungicides against collar rot of Muskmelon

Treatment	Disease incidence (%)	% disease decrease over control
Ridomil Gold 72 WP	18.12 E	79.95
Revus 250 SC	28.90 D	64.92
Success 72 WP	65.22 B	20.84
Aliette	36.00 C	56.31
Nanok 25 % SC	38.42 C	53.37
Control	82.40 A	
LSD	0.89	
[1]Means within a column sharing the same letter are not significantly different from each other at *P* = 0.05 according to Least Significant Difference Test.		

22. **EFFICACY OF DIFFERENT CHEMICALS AGAINST COLLAR ROT OF PEA CAUSED BY *PHYTOPHTHORA MEGASPERMA***

Seeds of Mateor were taken from Vegetable Research Institute, Faisalabad. Experiment was conducted in experimental area of Plant Pathology Section. Efficacy of five different chemicals (Ridomil Gold 72 WP@ 2.5 g/L, Revus 250 SC@ 2.4 ml/L, Aliette @ 1g/L, Curzate @ 2.5 ml/L, Success 72 WP @ 2.5mailto:WP@2.5 g/L) were evaluated against the collar rot disease under the field conditions. In control, nothing was applied. All agronomic practices were followed. Trial was sown in Randomized Complete Block Design with three repeats. Disease incidence (%) data were recorded after 10 days of the treatments application. Among five chemicals, Ridomil Gold 72 WP was found most effective against the collar rot disease as compared to the other chemicals. Success 72 WP was found least effective to control the disease but was effective when compared to the control where nothing was applied. In control treatment, maximum disease incidence was recorded.

Efficacy of different chemicals against collar rot of pea

Treatments	Disease Incidence (%)	% decrease/increase over control
Ridomil	20.25 F	77.56
Revus	31.95 E	64.59
Aliette	45.75 D	49.30
Curzate	58.50 C	35.18
Success	72.30 B	19.88
Control	90.25 A	

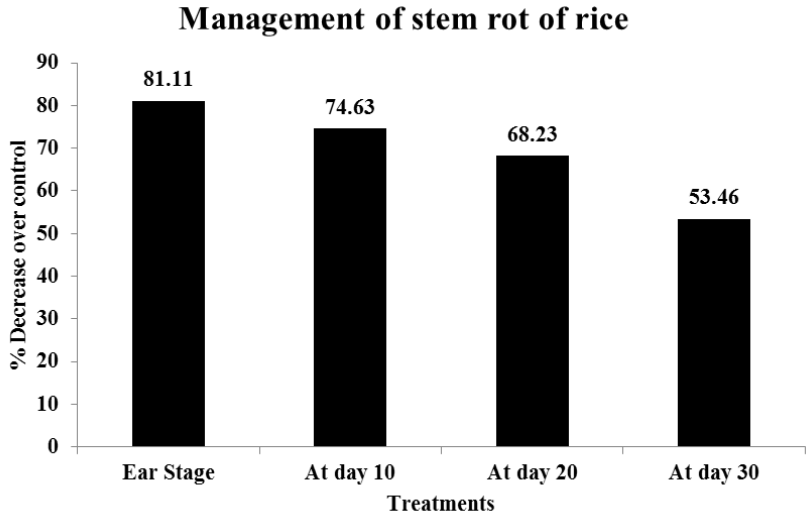
23. MANAGEMENT OF STEM ROT OF RICE

The experiment was conducted on 30-05-2019 in the wire house of Plant Pathology Research Institute, Faisalabad. Nursery was transplanted in earthen pots. The experiment was laid out in randomized completely block design (RCBD) with four replications.

Treatments

T1= at ear stage
T2= 10 days after first chemical application
T3= 20 days after first chemical application
T4= 30 days after first chemical application
T5= Control

Sick soil was be prepared by adding sclerotia @ 100 sclerotia / m^2 of soil. Chemical were sprayed as described in treatments. 2nd and 3rd spray of fungicides was done at ten days interval. Disease data was recorded before and after fungicides application.



Evaluation of chemicals against stem rot of rice

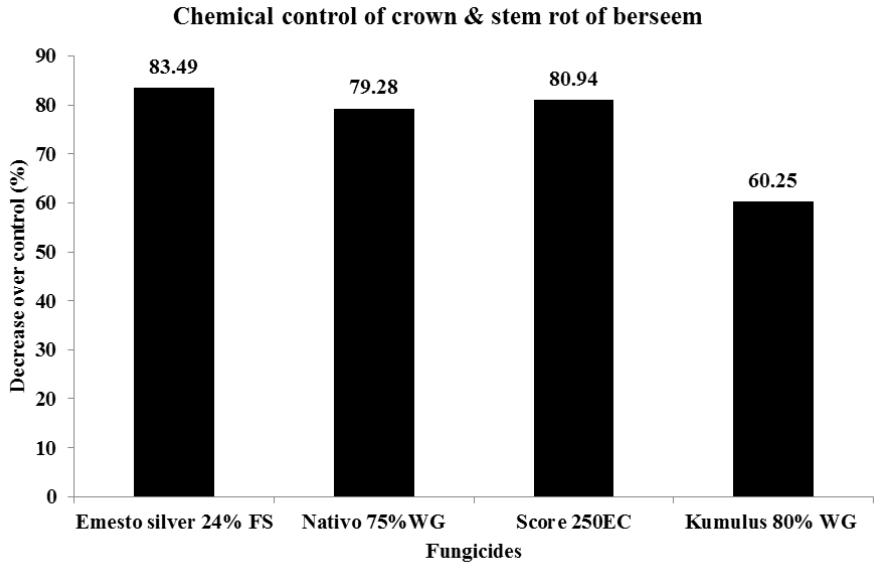
24. **CHEMICAL CONTROL OF STEM AND CROWN ROT OF BERSEEM CAUSED BY *Sclerotinia trifoliorum***

The experiment was conducted in the research area of Plant Pathology Research Institute, Faisalabad. The experiment was laid out on 15-11-2019 in completely randomized block design with four replications.

Treatments

T1= Control (Deep ploughing only)
T2= Emesto FS24% (PENFLUFEN) @ 2.0 ml/L of water in Mid- December (after first cutting only)
T3= Emesto FS24% (PENFLUFEN) @ 2.0 ml/L of water in Mid- December + Mid- January (after first and second cutting only)
T4= Emesto FS24% (PENFLUFEN) @ 2.0 ml/L of water after first, second and 3rd cutting

Sick field was prepared by adding mass culture of the pathogen (100 Sclerotia per 10 m2). Spray of Chemicals was done thoroughly to cover the soil on the appearance of the disease as per treatments. Data was recorded according to disease rating scale before cutting. The results are given in Fig. v.



Evaluation of chemicals against crown & stem rot of berseem

CHEMICAL CONTROL OF BACTERIAL BLIGHT OF GUAVA

The experiment was conducted in the research area of Horticulture Research Institute, Faisalabad. The experiment was laid out in randomized completely block design (RCBD) with four replications.

Treatments

T1= Bordeaux mixture @ 4:4:50

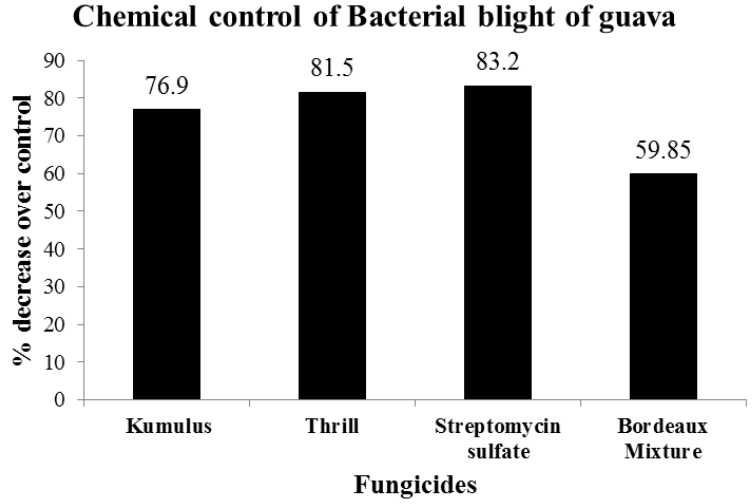
T2= Kumulus @ 3kg/acre

T3= Thrill 20% WP (Bismerthazole) @ 2gm/lit. of water

T4= Streptomycin sulfate @ 1cc/lit of water

T5= Control

The diseased branches, leaves and fruits were pruned and burnt. Chemicals were sprayed in the month of April after fruit setting. 2nd spray of Bactericide was done after the rains at the end of April or 1st week of May. 3rd Bactericidal spray was done after the moon soon rains. Disease data was recorded before and after Bactericide application. The results are given in Fig iii.



Evaluation of different chemicals against bacterial blight of guava

25. EFFICACY OF FUNGICIDES FOR THE CONTROL OF POWDERY MILDEW OF PEAS (*Erysiphae polygoni*).

The Experiment was soon on 05.11.2019 in RCBD with three replications in the research area of Plant Pathology Research Institute, Faisalabad.

Treatments

T1= Score 250EC (Difenconazole) @ 1ml/liter of water.
T2= Baytan foliar 250EC (Triadimenol) @ 0.5 cc/liter of water.
T3= Tegula (Tebaconazole) @ 1.5ml/lit of water.
T4= Topas 100 EC (Penconazole) @ 0.5 ml/lit of water.
T5= Sulfex Gold 80% WDG (Sulphur) @ 5.0 gm/lit of water.
T6= Control.

On the appearance of the disease fungicides were sprayed. Data of disease was collected on Singh et.al, 2015.

EFFICACY OF FUNGICIDES FOR THE CONTROL OF POWDERY MILDEW OF PEAS (*E. polygoni*).

Sr. No.	Treatments	Disease severity %	% decrease over Control
1.	Score 250EC (Difenconazole) @ 1ml/liter of water.	13.00	53.57
2.	Baytan foliar 250EC (Triadimenol) @ 0.5 cc/liter of water.	11.22	59.92
3.	Tegula (Tebaconazole) @ 1.5ml/lit of water.	8.00	71.43
4.	Topas 100 EC (Penconazole) @ 0.5 ml/lit of water.	8.11	71.03
5.	Sulfex Gold 80% WDG (Sulphur) @ 5.0 gm/lit of water.	9.98	64.36
6.	Control	28.00	-

26. EFFICACY OF FUNGICIDES FOR THE CONTROL OF STEMPHYLIUM BLIGHT OF ONION CAUSED BY *Stemphylium botryosum*.

The Experiment was soon on 05.11.2019 in RCBD with three replications in the research area of Plant Pathology.

Treatments

T1= Topsin-M 72 WP (Thiophanate Methiyl) @ 2.0gm/liter of water.
T2= Acrobat MZ 690 (Mancozeb + Dimathamorph) @ 2.0gm/liter of water.
T3= Bordeaux mixture @ 3:3:50.
T4= Score 250EC (Difenconazole) @ 1.0 cc/lit of water.
T5= Control.

On the appearance of the disease fungicides were sprayed. Data of disease was collected by disease rating scale of Sharma 1989.

EFFICACY OF FUNGICIDES FOR THE CONTROL OF STEMPHYLIUM BLIGHT OF ONION CAUSED BY *Stemphylium botryosum*.

Sr. No.	Treatments	Disease severity %	% decrease over Control
1.	Topsin-M 72 WP (Thiophanate Methiyl) @ 2.0gm/liter of water.	9.33	67.06
2.	Acrobat MZ 690 (Mancozeb + Dimathamorph) @ 2.0gm/liter of water.	11.53	59.30

3.	Bordeaux Mixture @3:3:50.	12.0	57.64
4.	Score 250EC (Difenconazole) @ 1.0 cc/lit of water.	6.00	78.82
5.	Control.	28.33	-

27. CHEMICAL CONTROL OF STEM ROT OF SESAME

The Experiment was soon on 19.06.2019 in RCBD with four replications in the research area of Plant Pathology Section, PPRI, Faisalabad. The plot size was 40` X 50`. Four following fungicides were used according to given doses.

Treatments

T1= Nativo 75 WP (Tebuconazole + Trifloxystrobin) @ 1.0 gm/ liter of water
T2=Score250 EC (Difenoconazole) @ 1.0 cc/liter of water.
T3=Kocide 52.4 WP (Copper hydroxide) @ 2.5 gm/liter of water.
T4= Amistar Top 325 SC (Azoxystrobin + Difenoconazole) @ 2.5 cc/lit of water.
T5=Control

On the appearance of the disease fungicides were sprayed at stem. Data of disease was collected on plant mortality basis.

CHEMICAL CONTROL OF STEM ROT OF SESAME

Sr. No.	Disease incidence (Mortality % basis)				AV. Mortality % Age	% decrease over control
	R1	R2	R3	R4		
T1	13.75	12.5	15.0	16.63	14.47	58.48
T2	14.38	16.25	15.63	16.88	15.79	54.69
T3	28.13	32.50	31.25	30.63	30.63	12.10
T4	10.63	11.25	11.88	10.0	10.94	68.61
T5	30.63	31.25	36.88	40.43	34.85	-

28. CHEMICAL CONTROL OF GRAY MOLD OF TOMATO(*B. cinerea)*

The Experiment was soon on 15.01.2020 in RCBD with Four replications in the research area of Plant Pathology Section, PPRI, Faisalabad. The plot size was 15 X 3m. Four following fungicides were used according to given doses.

Treatments

T1=Kumulus 80 WP (Sulpher) @ 2.0 gm/liter of water
T2=Acrobat –MZ 69% WP (Difenoconazole) @ 2.0 gm/liter of water.
T3=Tegula 12.5EW (Tebuconazole) @ 2.0 cc/liter of water.
T4= Amistar Top 325 SC (Azoxystrobin + Difenoconazole) @ 2.0 cc/lit of water.
T5= Control

On the appearance of the disease fungicides were sprayed. Application of fungicides were repeated thrice at an interval of 7-10 days. Data was recorded on % Leaf area infected basis.

CHEMICAL CONTROL OF GRAY MOLD OF TOMATO(*B. cinerea)*

Sr. No.	Treatments	Disease severity % age of leaves and stem area				Average	% Decrease over control
T1	Kumulus 80 WP (Sulpher) @ 2.0 gm/liter of water	R1	R2	R3	R4	27.5	37.5
		24	31	28	27		
T2	Acrobat –MZ 69% WP (Difenoconazole) @ 2.0 gm/liter of water.	15	10	18	17	15.0	65.91
T3	Tegula 12.5EW (Tebuconazole) @ 2.0 cc/liter of water.	14	19	13	20	16.5	62.5
T4	Amistar Top 325 SC (Azoxystrobin + Difenoconazole) @ 2.0 cc/lit of water.	8	10	11	6	8.75	80.11
T5	Control	38	44	50	44	44.0	-

29. CHEMICAL CONTROL OF LATE BLIGHT OF TOMATO

The Experiment was soon on 15.01.2020 in RCBD with Four replications in the research area of Plant Pathology Section, PPRI, Faisalabad.. The plot size was 15 X 3m. Four following fungicides were used according to given doses.

Treatments

T1= Revus (Cymoxanil+ MZ) @2gm /lit of water.
T2= Ridomil Gold (Mefenoxam +MZ) @ 2.0 cc/lit of water.
T3= Amistar Top 325 SC (Azoxystrobin + Difenoconazole) @ 2.0 cc/lit of water.
T4=Acrobate MZ (Dimethomorph + Mancozeb) @2.5g/lit of water.
T5= Dew 25% E (Difenoconazole) @ 2.00ml/lit of water.
T6= Control.

On the appearance of the disease fungicides were sprayed. Application of fungicides were repeated thrice at an interval of 10-15 days. Data was recorded on % Leaf area infected basis.

CHEMICAL CONTROL OF LATE BLIGHT OF TOMATO

Sr. No.	Treatments	Disease severity % age of leaves and stem area				Average	% Decrease over control
T1	Revus (Cymoxanil+ MZ) @2gm /lit of water.	R1	R2	R3	R4	7.75	41.53
		8	8	8	7		
T2	Ridomil Gold (Metalaxyl + Mancozeb) @ 2g/lit of water.	7	5	8	7	6.75	85.01

T3	Amistar Top 325 SC (Azoxystrobin + Difenoconazole) @ 2.0 cc/lit of water.	13	10	8	8	9.75	78.09
T4	Acrobate MZ (Dimethomorph + Mancozeb) @2.5g/lit of water.	17	22	16	15	17.50	60.67
T5	Control	33	45	50	50	44.50	-

30. BIOCHEMICALS EVALUATION OF ESSENTIAL OIL FOR THE CONTROL OF BROWN SPOT OF RICE

One fungicide & Two Plant essential oils were evaluated to control Brown spot of rice. Lemongrass essential oil at 1000ppm followed by eucalyptus essential oil at 1000ppm showed effectiveness to control the diseases as they reduced the disease over control by 80.00 and 77.00% respectively.

Sr. No.	Treatments	Disease severity %	% Decrease over control
1.	T1=Lemongrass Essential oil @ 1000ppm	9	80
2.	T2= Lemongrass Essential oil @ 500ppm	14.5	69
3.	T3= Eucalyptus Essential oil @ 1000ppm	10.5	77
4.	T4= Eucalyptus Essential oil @ 500ppm	18.6	61
5.	T5= Nativo	10.9	76
6	T6= Control	47	0

31. EVALUATION OF BIOCHEMICALS (ESSENTIAL OILS) FOR MANAGEMENT OF GREY MOLD OF TOMATO

Fresh Culture (Spore suspension) of the pathogen was sprayed on tomato plants to create disease. The trial was conducted in the Earthen Pots. Test essential oils were sprayed on the appearance of the disease. Application of Test essential oils was repeated thrice at an interval of 7-10 day. Disease severity data was recorded.

Sr. No.	Treatments	Disease severity %	% Decrease over control
1.	T1=Lemongrass Essential oil @ 1000ppm	12	74.47
2.	T2= Lemongrass Essential oil	14.5	69.15

	@ 500ppm		
3.	T3= Eucalyptus Essential oil @ 1000ppm	13.25	71.28
4.	T4= Eucalyptus Essential oil @ 500ppm	15.5	67.02
5.	T5= Radomil Gold @ 2.gm/lit of water.	12.5	72.34
6	T6= Control	47	0

Seed Pathology

STUDIES ON SEED BORNE MYCOFLORA OF COTTON

Seed samples of cotton were collected from different districts of Punjab and analyzed for presence of seed born fungi using SBM (Standard blotter method) technique. Results are given in Table 1.

Sr. No.	Fungi recorded	Average %age	Name of disease
1	*Alternaria alternata*	12.17	Alternaria blight
2	*Aspergillus flavus*	20.36	Boll rot
3	*Aspergillus niger*	17.02	Boll rot
4	*Botrytis cinerea*	6.7	Gray mold
5	*Chaetomium sp.,*	7.23	-
6	*Fusarium moniliforme*	5.28	Fusarium wilt
7	*Fusarium sp.,*	7.19	-
8	*Lasiodiplodia theobromae*	11.8	Wilting
9	*Nigrospora sp.,*	2.37	-
10	*Rhizopus stolonifer*	10.94	-

STUDIES ON SEED BORNE MYCOFLORA OF WHEAT

Seed samples of cotton were collected from different districts of Punjab and analyzed for presence of seed born fungi using SBM (Standard blotter method) technique. Results are given in Table 2.

Sr. No.	Fungi recorded	Frequency Average (%age)	Name of Disease
1.	*Alternaria alternata*	60.2	**Black Point (Storage disorder)**
2.	*A. triticina*	2.57	**Leaf Spot**

3.	*A. triticicola*	2.42	-
4.	*Cladosporium herbarum*	2.25	**Sooty Mould / Black Point (Storage disorder)**
5.	*Curvularia tritici*	1.56	**Black Point (Storage disorder)**
6.	*Cephalosporium spp.*	1.85	-
7.	*Drechslera graminea*	2.05	**Leaf Spot**
8.	*D. tetramera*	3.28	**Seed Rot (Storage disorder)**
9.	*D. halodes*	2.66	-
10.	*D. sorokiniana*	5.28	-
11.	*Fusarium moniliforme*	0.05	**Wilt**
12.	*F. graminearum*	0.25	**Head Blight**
13.	*F. solani*	1.14	**Wilt**
14.	*F. pallidorosium*	2.50	**Seed Rot (Storage disorder)**
15.	*Nigrospora spp.*	3.28	**Black Point (Storage disorder)**
16.	*Septoria nodorum*	2.56	**Glume Blotch**
17.	*Myrothecium graminearum*	0.8	**Leaf Spot**

STUDIES ON SEED BORNE MYCOFLORA OF RICE

Seed samples of cotton were collected from different districts of Punjab and analyzed for presence of seed born fungi using SBM (Standard blotter method) technique. Results are given in Table 3.

Sr. No.	**Fungi recorded**	**Frequency average %age**	**Name of disease**
1.	*Alternaria padwickii*	5.66	Leaf spot
2.	*Alternaria sp.,*	14.3	Leaf spot
3.	*Botrytis cinerea*	0.33	Leaf spot
4.	*Curvularia lunata*	7.54	-
5.	*Fusarium moniliforme*	5.23	Bakanae
6.	*Pyryicularia oryzae*	2.23	Blast
7.	*Bipolaris oryzae*	8.86	Brown spot
8.	*Aspergillus niger*	21.33	-

9.	*Aspergillus flavus*	27.67	-
10.	*Penicillium sp.*	4.98	-
11.	*Cercospora sp*	1.5	Leaf spot
12.	*Phoma sp*		

Nemotology

32. SURVEY OF POTATO CORE FOR DETECTION OF POTATO CYST NEMATODE (PCN)

One hundred and sixty seven (167) soil samples were collected during visits of five potato growing districts (Chiniot, Kasur, Okara, Sahiwal and Pakpatan) were processed for the detection of cysts of potato cyst nematode, *Globodera pallida* (White/pale cyst) and *Globodera rostochiensis* (yellow/Golden cyst) in Plant Nematology Laboratory, Plant Pathology Research Institute, Faisalabad. Soil samples were air dried and processed by following Floatation technique for detection of cysts of PCN. The data is given below.

Survey of Potato area for detection of potato cyst nematode

Sr no	**District**	**Samples tested**	**Cysts per g soil *(Globodeara spp)***
1	**Chiniot**	**32**	**0**
2	**Kasur**	**32**	**0**
3	**Okara**	**35**	**0**
4	**Sahiwal**	**35**	**0**
5	**Pakpattan**	**33**	**0**
Total	**167**		

Potato cyst nematode (*Globodeara spp*) was not detected from any sample out of 167 samples tested belonging to three districts.

33. SURVEY OF RICE CORE FOR DETECTION OF ROOT KNOT NEMATODE (***Meloidogyne gramnicola*****)**

One hundred and five (105) root samples were collected during visits of three rice growing districts (Hafizabad, Gujranwala and Sheikhupura). Samples were processed in Plant Nematology Laboratory, Plant Pathology Research Institute, Faisalabad for the detection of root knot nematode **(***Meloidogyne gramnicola***)** on roots of rice plants. The data is given below.

Survey of Rice area for detection of root knot nematode (RKN)

Sr no	**District**	**Samples tested**	**Cysts per g soil *Globodeara spp***
1	**Sheikhupura**	**35**	**02**
2	**Hafizabad,**	**35**	**04**

3	**Gujranwala**	**35**	**04**
Total	**105**		**10**

Rice root knot nematode (*M. gramnicola*) was detected from 10 samples out of 105 samples tested belonging to three districts.

34. SCREENING OF SUNFLOWER VARIETIES AGAINST ROOT KNOT NEMATODE (*Meloidogyne incognita*).

Ten varieties/ lines of sunflower along with susceptible check (FH-516) were collected from Oilseed Research Institute, Faisalabad and were tested against root knot nematode *M. incognita*. The experiment was conducted in a sick field at Plant Pathology Section, Plant Pathology Research Institute, Faisalabad. Each entry was sown on single ridge in sick field. Data was recorded on the basis of knots after 12 weeks of sowing by following Tayler and Sasser (0-5) Scale, 1978.

Evaluation of Sunflower germplasm against root knot nematode (*M. incognita)*

No. of knots	**Reaction**	**No. of Varieties/ Lines**	**Varieties/Lines**
0 = No knot	Immune	-	-
1 = 1-2 knots	Resistant	-	-
2 = 3-10 knots	Moderately Resistant	-	-
3 = 11-30 knots	Moderately Susceptible	-	-
4= 31-100 knots	Susceptible	10	20-B, 42-B, 43-B, 44-B, 62-B, 65-B, 73-B, 106-B, 90-B, FH-516
5 = >100 knots	Highly Susceptible	-	-
TOTAL		**10**	

None of the sunflower germplasm was found Immune/ Resistant against root knot nematode. All varieties / lines were found susceptible against root knot nematode.

35. SCREENING OF TOMATO GERMPLASM AGAINST ROOT KNOT NEMATODE (*Meloidogyne incognita*)

Nursery of tomato germplasm (35 entries) was collected from Vegetable Research Institute, Faisalabad along with susceptible check entry (Naqeeb). One month old tomato seedlings were transplanted singly in earthen pots having 2 kg sterilized soil in each pot at Plant Pathology Section, Plant Pathology Research Institute, Faisalabad. Nematode inoculum @ 2000J2s per pot was added in to each pot after 15 days of transplantation of tomato seedlings. The data was recorded by counting number of knots per root system after 12 weeks of transplantation of tomato seedlings in sick plot following Tayler and Sasser (0-5) Scale, 1978. The data is given below.

Evaluation of Tomato germplasm against *M. incognita*

No. of Galls / knots	Reaction	No. Of Varieties / Lines	Varieties/Lines
0 = No galls	Immune	-	-
1 = 1-2 galls	Resistant	-	-
2 = 3-10 galls	Moderately Resistant	5	LTH 539, 19297, 19300, 19312, 13234
3 = 11-30 galls	Moderately Susceptible	17	LTH 541, 545, 546, 543, 10139, 10142, 18277, 18282, 18311, 19308, 19309, 19310, 19312, 19314, 19298, 19297, 19696.
4 = 31-100 galls	Susceptible	5	LTH 540, LTH 544, 17256, 18299, 19245.
5 = > 100 galls	Highly Susceptible	8	LTH 542, 17257,18273, 19301, 19304, 19307, Naqeeb, Nadir
TOTAL		**35**	

None of the tomato germplasm was found Immune/ Resistant to root knot nematode. Five lines (LTH 539, 19297, 19300, 19312 & 13234) were found moderately resistant against *M. incognita.* Seventeen lines (LTH 541, 545, 546, 543, 10139, 10142, 18277, 18282, 18311, 19308, 19309, 19310, 19312, 19314, 19298, 19297 & 19696.) were found moderately susceptible against root knot nematode. Five lines (LTH 540, LTH 544, 17256, 18299 & 19245.) were found susceptible where as eight varieties / lines (LTH 542, 17257,18273,19301, 19304, 19307, Naqeeb & Nadir) were found highly susceptible to *M. incognita.*

36. SCREENING OF PEA GERMPLASM AGAINST ROOT KNOT NEMATODE (Meloidogyne incognita)

Pea germplasm (15 varieties/lines) collected from Vegetable Research Institute,Faisalabad along with susceptible check (Meteor) was sown on ridges in sick field at Plant Pathology Section, Faisalabad. Nematode inoculum level in sick plot was assessed before sowing of pea entries in sick field. Each entry was sown in single row. The data was recorded by counting number of knots per root system after 12 weeks of sowing of pea germplasm in sick plot following Tayler and Sasser (0-5) Scale, 1978. The data is given below.

Evaluation of Pea germplasm against *M. incognita* (FIELD)

No. of Galls / knots	Reaction	No. Of Varieties/ Lines	Varieties/Lines
0 = No galls	Immune	-	-
1 = 1-2 galls	Resistant	2	Lina park,Sarsabz
2 = 3-10 galls	Moderately Resistant	2	9374, 2100-40
3 = 11-30 galls	Moderately Susceptible	8	Pea-09,267,9800-5,PTL NO 3, PTL NO 7, Samrina zard, Climax, PTL NO 6.
4 = 31-100 galls	Susceptible	3	FS 2187, Meteor, 1300-8
5 = › 100 galls	Highly Susceptible	-	-
TOTAL		**15**	

Among 15 varieties/ lines tested, only two varieties (Lina-pak & Sarsabz,) were found resistant to *Meloidogyne incognita*. Two lines (9374 & 2100-40) were found moderately resistant where as eight varieties/ lines (Pea-09, 267,9800-5,PTL NO 3, PTL NO 7, Samrina zard, Climax & PTL NO 6.) were found moderately susceptible to root knot nematode. Three varieties/lines (FS 2187, Meteor & 1300-8) were found susceptible.

37. IN VITRO STUDIES ON THE POTENTIAL OF PLANT GROWTH PROMOTING RHIZOBACTERIA (PGPR) AGAINST ROOT KNOT NEMATODE (*Meloidogyne incognita*) ON EGGPLANT.

One month old eggplant nursery of susceptible variety (Dilnasheen) was transplanted in pots in glass house of Plant Pathology Section, Faisalabad. Five treatments were replicated penta folds and arranged in a Complete Randomized Design (CRD). Each pot contains single eggplant. The culture of bio-control agents (PGPR) was added @ 30ml/pot after one week of transplantation of eggplant susceptible nursery in pots. One week after, PGPR added pots were inoculated with root knot nematode @ of 1000 J_2s per pot. Eggplant pots having only root knot nematode inoculum was served as control. Data regarding number of knots was recorded after 6 weeks of inoculation of nematode following Tayler and Sasser (0-5) scale, 1978

Potential of plant growth promoting *Rhizobacteria* (PGPR) in the control of root knot nematode *M. incognita*) on eggplant

Treatments	No. of Knots	Percentage Decrease over Control
Pseudomonas fluorescens	29.7	84.81
Bacillus subtilus	19.7	89.92
Azotobacter sp.	35.1	82.05
Rhizobium sp.	51	73.92
Control	195.6	

All tested PGPRs testes have significantly reduced the development of knots on eggplant root systems over control. Maximum decrease in knots (89.92%) was found in *Bs* followed by *Pf* (84.81%), *Azoto* (82.05%) and *Rhiz* (73.92%) over control.

38. SCREENING OF POTATO GERMPLASM AGAINST COMMON SCAB (*Streptomyces scabies*).

Potato germplasm (Fifty varieties/lines) were collected from Potato Research Institute, Sahiwal and National Agriculture Research Centre, Islamabad. These genotypes were screened out in sick field. Sick field was prepared by applying the bacterium culture (multiplied on nutrient broth in lab) with irrigation and also continuous applying of bacterium culture with each irrigation. The experiment was laid out according to Augmented design with thirty replicates. After 120 days, tubers were harvested and data were recorded on basis of % scab infection by using Bjoer and Roer, 1980 scale Scab index.

REACTION OF POTATO GERMPLASM TO COMMON SCAB IN FIELD TRIAL.

Infected %age portion	Reaction	Varieties/Line	Total
<08	Resistant	Foda, Paramount, Esmee, Sarpeo Maria., Daisy	5
8-15	Moderately Resistant	PRI-Red, Cardinal, Hermosa, 2005-1, FSD-White, FD 73-44,Koroda, Astrix, FD 71-1, SL-28-72, Fortus, FD 74-30, FD 81-1, SL 40-5, SL 18-1, FD 74-50, FSD-Red, Cerata, Safaida, Lady Rosatta, Santae.	21
15-20	Moderately Susceptible	FD 1-3, Loane, Simply Red, Sadaf, Ruby, Mosica, Alloute, FD 73-49, FD 76-18, FD 73-110, SL 28-51, FD 73-44	12
20-24	Susceptible	FD 74-38, FD 78-51, FD 74-28, FD 76-55, FD 75-47,	7

		FD 76-67, SL-5-2	
>24	Highly Susceptible	FD 76-36, FD 73-38, FD 51-5, FD 69-1, Vogue.	5
	Total		**50**

Out of fifty varieties / breeding lines, five were found resistant and twenty one showed moderately resistant response against common scab (*S. scabies*). Twelve were found moderate susceptible against common scab. Seven exhibited susceptible response and five were found highly susceptible against common scab (*S. scabies*).

39. MANAGEMENT OF POTATO COMMON SCAB BY VARIOUS MEANS IN MICRO-PLOTS

Four chemicals and one biocontrol agents were tested against common scab of potato in micro plots as seed treatment on highly susceptible line FD 69-1. The experiment was arranged in RCBD. After 120 days, tubers were harvested and data were recorded on basis of % scab infection by using Bjoer and Roer, 1980 scale.

Management of potato common scab by various means in plots (Seed treatment)

Sr No	Name of Chemicals	Disease Severity	% Decrease over control
1	Fluazinam+metalaxyl-m	11.66	69.83
2	Streptomycin sulphate	11.7	69.73
3	Fludioxonil+Azoxystrobin+Clothianidin	12.13	68.62
4	Kasugamycin	13.00	66.37
	Bio-control		
1	*Bacillus subtilis*	9.58	75.21
	Control	38.66	

In micro plots (seed treatments) maximum % disease control was noted in Fluazinam+metalaxyl-m (69.83) followed by Streptomycin sulphate (69.73), Fludioxonil + Azoxystrobin + Clothianidin (68.62) and Kasugamycin (66.37) over control respectively. While among bio control agent *Bacillus subtilis* % disease control was 75.21 over control.

40. ELIMINATION OF POTATO VIRUSES FROM MICRO PROPAGATING POTATO VARIETIES.

A. At Faisalabad

Meristem culture of different potato varieties Cardinal was done. Test tube then placed in incubation room under aseptic condition at 22 ^{o}C to 25 ^{o}C temperature. These saplings were

again sub cultured into 8-10 test tubes by using its node cuttings. These test tubes were grown upto full length of the tube covering with sterilized poly propylene film. After 25 days, these plants transferred into sterilized sand trays for 15 days to become acclimatized with atmosphere then shifted into pots and placed at glass house with 25 ^{o}C to 28 ^{o}C. After the maturity, these were kept for further multiplication. At Faisalabad 36238 mini tubers were produced.

B. At Murree

The same procedure as mentioned above was adopted to produce disease free micro tubers at Murree. After the maturity of crop (2740 micro tubers) were obtained & kept for further multiplication. The detail is given in table below.

Varieties/Lines	**Micro tubers produced**	
	Faisalabad	**Murree.**
Mosica, Simply Red, Astrix, Karoda & Cardinal	2050	2740
Total:	**4790**	

41. PRODUCTION OF VIRUS FREE MINI TUBERS FROM MICRO PROPAGATED POTATO VAREITIES AT FAISALABAD.

Micro tubers were planted in tunnels. Plantlets produced from single node were kept in sterilized sand trays for 7-10 days for acclimatization. Stem cutting 2-3 inches from top were treated with rooting hormone and transplanted in sand trays. Later these saplings were transplanted in tunnels in month of October and November at Faisalabad. These tunnels were covered with plastic sheets to avoid entry of insect vectors. Haulms were cut on the appearance of vector i.e. (*Myzus persicae*.). Proper agronomic operations and plant protection measures were carried out at proper stages of the crop. The virus diseased infection was detected through ELISA during crop season. The potato crop was certified by the Federal Seed Certification Department. Mini tubers were harvested in the month of January-February and after sorting were kept in cold store for use as autumn crop. Mini tubers produced in the tunnels will be utilized for the production of pre basic potato seed. Mini tuber production was carried out under tunnels at Faisalabad. **38,288** (ELISA tested) mini tubers of same potato varieties were produced. **12,000** kg of diseases free pre basic potato seed was produced from SH-5, Karoda and Cardinal.

Varieties/ Lines	Total mini tubers obtained
Karoda, Cardinal, SH- 5	38,288

42. PRODUCTION OF PREBASIC SEED POTATO

For the production of pre basic seed potato healthy mini tubers of three project varieties i.e. Karoda, Cardinal, SH- 5 were planted in separate seed production blocks. Recommended fertilizer dose and timely irrigations were applied. Other cultural practices and plant protection measures were also carried out for better crop growth and development. Rouging of undesirable and diseased plants was undertaken at 45 and 60 days after sowing. The virus diseases infection was detected through ELISA at suitable stages of the crop. Later, the potato crop was certified by the Federal Seed Certification & Registration Department. Yellow trays & Sticky traps were used for viral diseases vectors study. De-haulming was undertaken at the appearance of the vector of potato virus diseases to avoid the transmission of viruses. The crop was harvested at the maturity. The seed thus obtained were graded and preserved for experiments and for sale to interested growers and Seed Companies. During the year, **100 bags** (100 kg) of pre basic potato seed were produced.

43. SCREENING OF DIFFERENT GENOTYPES OF POTATOES AGAINSTAPHID

Twenty Two genotypes of potato were sown in RCB design with three replications of each genotype at experimental area of Plant Virology Institute, Plant Pathology Research Institute, AARI, Faisalabad. The size of the plot was 5x2 meter square. The distance between rows and plants was 75 cm and 20 cm respectively, using recommended agronomic practices. The genotypes include FD 73-44, FD 1-3,FD 73-49,FD 74-30,FD 73-73, SL 10-4, SL 5-2,SL-9-14,SL-28-72, FD White, Ruby, Sadaf, Cosmo, Sahiwal White Sahiwal Red,PRI Red, FD 74-38, FD 81-1, FD 74-28, FD 76-59, FD 76-55 and FD 76-1. The whole experiment was kept free from all kind of pesticide application for fair evaluation of genotypes. The data of aphid population was recorded in such a way that fifteen plants at random were selected from each replication. The aphid population per leaf was checked from the leaf of first plant from upper portion, 2nd leaf from central portion of the second plant and third leaf from the lower portion of the third plant and the procedure continues.

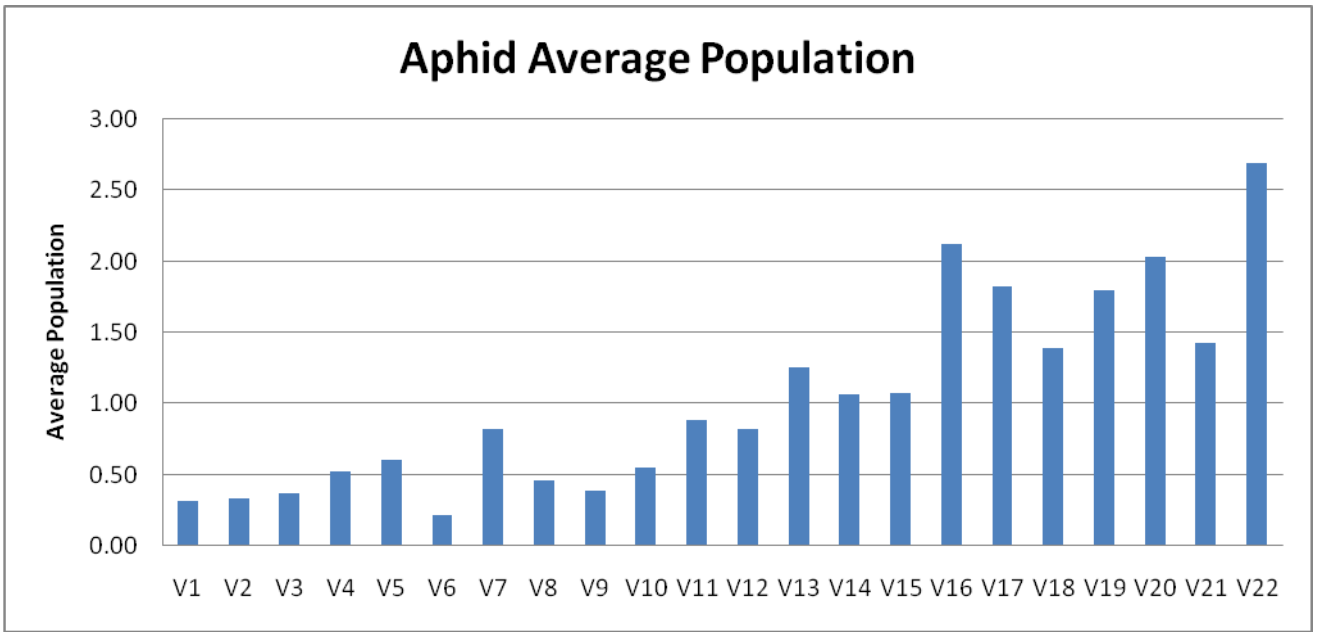
TABLE: Screening of Different Potato Genotypes against Aphid

Varieties/Genotypes		Avg. Aphid/ Leaf
V1	FD 73-44	0.32 (0.07-2.00)
V2	FD 1-3	0.33 (0.07-1.44)

V3	FD 73-49	0.37 (0.02-1.33)
V4	FD 74-30	0.53 (0.11-1.69)
V5	FD 73-73	0.61(0.02-1.60)
V6	SL 10-30	0.21(0.02-1.33)
V7	SL 5-2	0.82(0.02-2.67)
V8	SL 9-14	0.46(0.02-1.96)
V9	SL 28-72	0.39 (0.02-2.56)
V10	FD White	0.56 (0.02-1.24)
V11	Ruby	0.89 (0.04-3.33)
V12	Sadaf	0.82 (0.04-4.09)
V13	Cosmo	1.25 (0.02-6.56)
V14	Sahiwal White	1.07 (0.02-6.11)
V15	Sahiwal Red	1.07(0.04-5.33)
V16	PRI Red	2.12 (0.04-10.22)
V17	FD 74-38	1.83 (0.02-8.00)
V18	FD 81-1	1.39 (0.02-9.22)
V19	FD 74-28	1.80 (0.02-12.44)
V20	FD 76-59	2.04 (0.02-10.44)
V21	FD 76-55	1.43 (0.02-7.00)
V22	FD 76-1	2.70 (0.02-14.22)

Results indicated that minimum population of aphid per leaf were recorded on SL 10-30(0.21)followed by FD 73-44 with value of 0.32. On the other hand, FD 76-1 has the highest population of aphid per leaf with the value of (2.70).the graphical representation of data is given below which clearly depicts the above results.

GRAPH: Studies on population of aphid on different genotypes of potato.



VIRAL DISEASES

Numerous pathogen attack the potato crop. The data of disease was also observed to check the disease incidence of PLRV and PVY. The presence of disease was observed by visual observation. The disease percentage was calculated with the help of following formula:

$$\text{Percentage of disease} = \frac{\text{Number of diseased plants}}{\text{Total number of plants}} \times 100$$

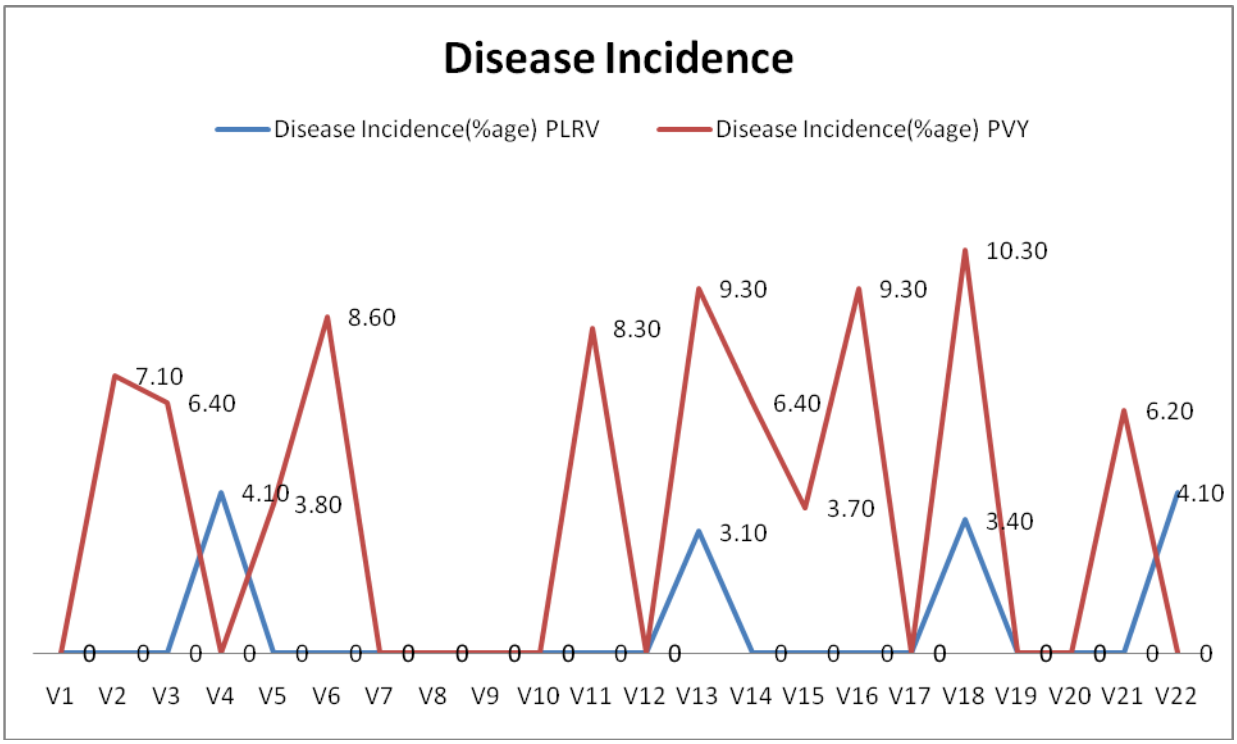
TABLE: Percentage of Disease Incidence (PLRV and PVY)

Variety No.	Variety Name	Disease Incidence(%age)	
		PLRV	PVY
V1	FD 73-44	0	0
V2	FD 1-3	0	7.10
V3	FD 73-49	0	6.40
V4	FD 74-30	4.10	0
V5	FD 73-73	0	3.80
V6	SL 10-30	0	8.60
V7	SL 5-2	0	0
V8	SL 9-14	0	0
V9	SL 28-72	0	0

V10	FD White	0	0
V11	Ruby	0	8.30
V12	Sadaf	0	0
V13	Cosmo	3.10	9.30
V14	Sahiwal White	0	6.40
V15	Sahiwal Red	0	3.70
V16	PRI Red	0	9.30
V17	FD 74-38	0	0
V18	FD 81-1	3.40	10.30
V19	FD 74-28	0	0
V20	FD 76-59	0	0
V21	FD 76-55	0	6.20
V22	FD 76-1	4.10	0

Results revealed that Cosmo has minimum percentage of PLRV with value of 3.10% followed by FD 81-1 while FD 74-30 and FD 76-1 has maximum percentage of PLRV both having 4.10%. In case of PVY Sahiwal Red has minimum percentage of disease having value of 3.70 %. On the other hand FD 81-1 has highest percentage of PVY with value of 10.30%.

GRAPH: Percentage of Disease Incidence



EVALUATION OF NEW CHEMISTRY INSECTICIDES AGAINST APHID *(MYZUS PERSICAE)*IN POTATO CROP:

The efficacy of eleven new insecticides viz. Ulalla50% WDG, Confidor200 SL, Telsta20% SC, SavintoPRIME 200 SL, Polo 500 SC and Safina 4.89% SC were tested against Aphid *(Myzuspersicae)*in Potato crop. Trial was conducted in the RCBD with three repeats having plot size 5m x 10m in the research area of Plant Virology section, PPRI, Faisalabad. Treatments were applied when pest reached ETL. Aphid population was recorded before and after 3 & 7 days of spray from 15 randomly selected upper, middle and lower leaves of 15 plants per plot.Data so obtained will be analyzed statistically. Beneficial's data were recorded from randomly selected five plants per plot.

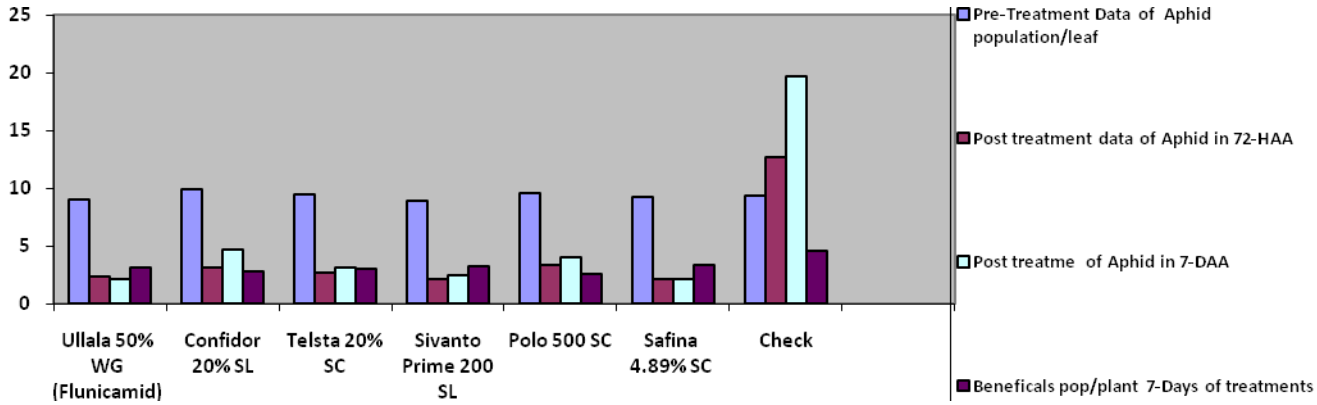
TABLE: EFFICACY OF NEW INSECTICIDES AGAINST APHID *(MYZUS PERSICAE)*IN POTATO CROP.

Treatments	Dose/acre (ml/gm)	Pre-Treatment Data of Aphid population/leaf	Post-Treatment Data of Aphid pop./leaf	% Mortality	Beneficial's pop/plant	Beneficial's % Survival

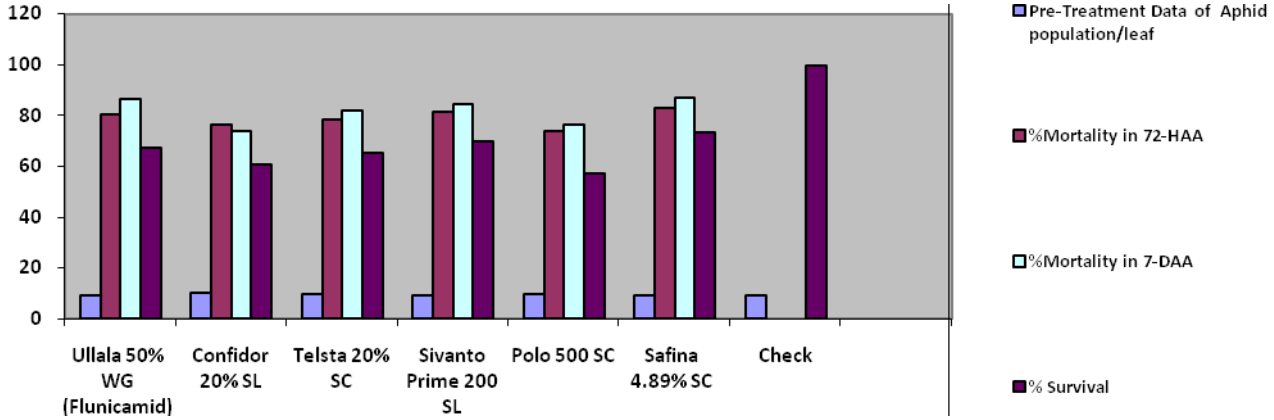
				72-HAA	7-DAA	72-HAA	7-DAA	after 7-Days of treatments	
T1	Ullala 50% WG (Flunicamid)	60 gm	9.00	2.33	2.13	80.57	86.74	**3.07**	**67.24**
T2	Confidor 20% SL (Imidacloprid)	250 ml	9.93	3.07	4.67	76.40	73.91	**2.80**	**60.72**
T3	Telsta 20% SC (Chlothianidin)	200 ml	9.40	2.67	3.07	78.66	81.79	**3.00**	**65.19**
T4	Sivanto Prime 200 SL (Flupyradifuron)	250 ml	8.87	2.13	2.47	81.75	84.41	**3.20**	**70.03**
T5	Polo 500 SC (Diafenthiuron)	200 ml	9.60	3.33	4.00	73.84	76.64	**2.60**	**57.11**
T6	Safina 4.89% SC(Afidopyropen/ Inscalis)	400 ml	9.27	2.13	2.13	82.80	87.23	**3.33**	**73.37**
T7	Check	60 gm	9.33	12.67	19.67	0.00	0.00	**4.53**	**100.00**
	LSD at 5%								

Results indicated that Safina 4.89% SC(Afidopyropen/ Inscalis) @ 400 ml /acre gave the maximum pest mortality (82.80%) followed by Sivanto Prime 200 SL (Flupyradifuron)with percentage mortality of 81.75 % while the minimum pest mortality (73.84%) was observed in plots treated with Polo 500 SC (Diafenthiuron) @ 200 ml/acre after 72 hours of treatment. After 7 days of application maximum mortality (87.23%) was recorded in plot treated withSafina 4.89% SC(Afidopyropen/ Inscalis) @ 400 ml/acre while minimum (73.91%) was recorded in Confidor 20% SL (Imidacloprid) @ 250 ml/acre.

GRAPH: Field Bio-efficacy on new insecticides against aphid on potato after 72-HAA



Field Bio-efficacy on new insecticides against aphid on potato after 7-DAA



COTTON

44. SCREENING OF DIFFERENT COTTON GENOTYPES AGAINSTINSECT PESTS

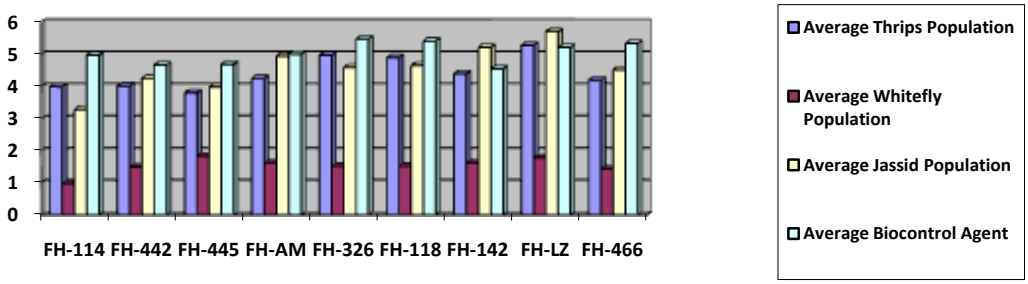
Nine Cotton genotypes viz **FH-144, FH-442, FH-445, FH-AM, FH-326, FH-118,FH-142, FH-LZ and FH-466**with four replications were sown in the research area of Plant Virology Section, Plant pathology Research Institute, AARI, Faisalabad. The trial was laid out in RCB Design having four replications. The experiment was kept free from all types of pesticide application for fair evaluation of genotypes. The data of whitefly, jassid and thrips were recorded in such a way that 15 leaves of 15 plants selected at random in each replication. The leaves were observed in such a way that one leaf from the upper part of the first plant; second one from the middle part of the second plant and the third one from the lower part of the third plant of each variety and so on. The population of bio control agents was also recorded from 15 plants selected at random. The data recorded are as under:-

TABLE: Screening Of Different Cotton Genotypes against Insect Pests Complex

Varieties/Genotypes		AvgThrips / Leaf	Avg Whitefly/ Leaf	Avg Jassid/ Leaf	Avg Bio control/ plant
V1	**FH-114**	3.99 (1.70-8.78)	0.98 (0.58-1.65)	3.28 (0.87-6.67)	4.99 (1.35-7.10)
V2	**FH-442**	4.02 (0.52-10.63)	1.49 (0.62-4.08)	4.25 (1.58-7.38)	4.67 (1.50-6.50)
V3	**FH-445**	3.80 (0.65-8.85)	1.83 (0.73-5.88)	3.98 (1.00-10.70)	4.69 (0.95-6.60)
V4	**FH-AM**	4.25 (0.65-8.50)	1.61 (0.60-5.17)	4.95 (1.30-8.70)	5.01 (1.25-6.45)
V5	**FH-326**	4.97 (1.40-9.25)	1.52 (0.80-3.95)	4.59 (1.30-10.20)	5.50 (1.65-7.55)
V6	**FH-118**	4.90 (1.85-10.65)	1.52 (0.80-4.42)	4.65 (1.25-10.00)	5.41 (1.75-7.25)
V7	**FH-142**	4.39 (1.30-9.05)	1.61 (0.75-4.38)	5.22 (2.55-10.50)	4.55 (1.30-5.80)
V8	**FH-LZ**	5.28 (2.25-8.20)	1.79 (0.75-5.00)	5.70 (2.33-11.35)	5.23 (1.50-6.75)
V9	**FH-466**	4.20 (0.95-9.30)	1.43 (0.73-2.58)	4.52 (1.48-10.15)	5.35 (2.00-7.15)

Results indicated that average whitefly population/leaf with minimum population (0.98/leaf) on FH-114 whereas maximum whitefly population (1.83/leaf) was observed on genotype FH-445. In case of Jassid, minimum population (3.28) per leaf was recorded on genotypes FH-114whereas maximum Jassid population (5.70/leaf) was observed on genotype FH-LZ. Thrips population remained below ETL throughout the season with minimum 3.80/leaf on FH-445followed by FH-AM(4.25/leaf), where as maximum (5.28Thrips/leaf) was recorded on genotype FH-LZ. Minimum (4.52) bio control agents was recorded on genotype FH-142 with population (4.55/leaf) respectively, whereas maximum (5.50/leaf) was observed on genotype FH-326.

GRAPH: Studies on population of insect pest on different genotypes of Cotton



Physio-morphic characters of Cotton:

Various physio-morphic plant characters were studied at the crop maturity when the plants were green. Leaves were collected, sealed in transparent white plastic bags and transported to the laboratory for analysis. The different physio-morphic characters are given below:

1) Chlorophyll reading of Cotton Leaf:

The 3 plants were randomly selected in each genotypes within each replications, total 3 leaves (The leaves were observed in such a way that one fully expanded leaf from the upper part of the first plant; second one from the middle part of the second plant and the third one from the lower part of the third plant of each variety) and their chlorophyll reading noted with the help of chlorophyll meter .The average chlorophyll reading of leaves are given below:

Varieties/Genotypes		**R1 Average**	**R2 Average**	**R3 Average**	**R4 Average**
V1	**FH-114**	49.97	43.47	52.86	43.066
V2	**FH-442**	40.93	51.80	46.3	39.9
V3	**FH-445**	44.03	49.83	44.93	44.46
V4	**FH-AM**	46.63	43.13	53.1	45.86
V5	**FH-326**	46.60	47.83	49.5	51.4
V6	**FH-118**	51.77	43.20	43.53	41.66
V7	**FH-142**	52.67	40.03	49.133	49.7
V8	**FH-LZ**	49.60	49.96	47.66	40.66
V9	**FH-466**	52.23	54.76	48.166	48.166

45. Leaf Area of Cotton:

The 3 plants were randomly selected in each genotypes within each replications, total 3 leaves (The leaves were observed in such a way that one fully expanded leaf from the upper

part of the first plant; second one from the middle part of the second plant and the third one from the lower part of the third plant of each variety) and their leaf area noted with the help of leaf meter.The average leaf area of leaves are given below:

Varieties/Genotypes		**R1 Average**	**R2 Average**	**R3 Average**	**R4 Average**
V1	**FH-114**	111.015	69.979	84.161	117.996
V2	**FH-442**	123.9966	114.41	84.207	72.271
V3	**FH-445**	90.499	106.52	87.92	87.416
V4	**FH-AM**	99.7793	109.99	77.096	52.294
V5	**FH-326**	92.5586	111.116	87.37	121.96
V6	**FH-118**	122.23	93.784	76.94	83.52
V7	**FH-142**	131.056	126.97	60.790	100.74
V8	**FH-LZ**	133.88	98.79	85.066	102.57
V9	**FH-466**	123.36	106.52	87.782	123.54

46. Hair density of Cotton leaf:

The 3 plants were randomly selected in each genotypes within each replications, total 3 leaves (The leaves were observed in such a way that one fully expanded leaf from the upper part of the first plant; second one from the middle part of the second plant and the third one from the lower part of the third plant of each variety) and their hair-density noted at the different spots like main vain with 2 other vain under a stereo microscope. The average hair density of different leaves are given below:

Varieties/Genotypes		**R1 Average**	**R2 Average**	**R3 Average**	**R4 Average**
V1	**FH-114**	15.67	17.33	14.44	18.00
V2	**FH-442**	17.89	15.00	18.33	13.44
V3	**FH-445**	14.11	16.33	17.33	14.11
V4	**FH-AM**	17.78	14.78	20.00	17.78
V5	**FH-326**	13.11	16.89	17.67	16.67
V6	**FH-118**	18.89	14.78	14.89	17.67

V7	**FH-142**	11.89	15.78	16.33	21.00
V8	**FH-LZ**	14.44	17.67	14.67	17.44
V9	**FH-466**	18.33	18.56	17.78	15.89

47. SCREENING OF DIFFERENT GENOTYPES/ LINES OF ONION AGAINST IRIS YELLOW SPOT VIRUS.

Out of **20** genotypes **7** varieties (Red imposta, Hon 300 A, Hon 303 D, VR10-7, Sultan, VR10-8 and VR10-2) were Highly Resistant (HR), **4 (**VR 10-6, On 12-15, NR-1 and VR10-4**)** were resistant (R), **2** were **(**NO. 96 and Rosa bella) Moderately Resistant (MR), **5** were **(**Rania VR 1, NR-1, Golden VR1 ORB, VR10-5, Hon 304 E) Susceptible (S) and **2** (Glory and Gulzar) were Highly Susceptible (HS).

Disease rating scale	**Reaction**	**Name of variety**	**No. of varieties**
0	HR	Red imposta, Hon 300 A, Hon 303 D, VR10-7, Sultan, VR10-8 and VR10-2	7
1	R	VR 10-6, On 12-15,NR-1 and VR10-4	4
2	MR	NO. 96 and Rosa bella	2
3	S	Rania VR 1, NR-1, Golden VR1 ORB, VR10-5, Hon 304 E	5
4	HS	Glory and Gulzar	2

48. PREVALENCE OF CUCUMBER MOSIAC VIRUS IN DIFFERENT CUCUMBER VARIETIES

Total **18** varieties were screened against cucumber mosaic virus (CMV). **8** variety (Prince star R2 F1, TCB-801, TCB 802, TCB 803, 1805, HCU 1171B, OZ and Hsham-F1) were found Resistant (R), **4** (Yeilder, Winner 7001, Winner SPA-2 and Liner) were Moderately Resistant (MR), **3 (**Subhan F1, Winner KJ8 and Winner V55) moderately susceptible (MS), **1 (**DP 01) Susceptible (S) and **2** (Maxwell and Sahar-F1) was found Highly Susceptible (HS).

Disease rating scale	Reaction	Name of variety	No. of varieties
0	HR	-	-
2	R	Prince star R2 F1, TCB-801, TCB 802, TCB 803, 1805, HCU 1171B, OZ and Hsham-F1	8
4	MR	Yeilder, Winner 7001, Winner SPA-2 and Liner	4
6	MS	Subhan F1, Winner KJ8 and Winner V55	3
8	S	DP 01	1
10	HS	Maxwell and Sahar-F1	2

- Yang *et al* 1996

49. REACTION OF VARIOUS GENOTYPES / LINES OF TOMATO AGAINST TOMATO YELLOW LEAF CURL VIRUS

Out of **15** varieties **5** (17256, 10139, 19308, 19299 and 18282) were resistant, **3** (18277, 191313 and 19309) moderately resistant (MR), **3 (**Rio grande, AT1811 and 19297**)** moderately susceptible (MS), **2 (**Nagina and 17257) were susceptible (S) and **2** (Nadir and Naqeeb) were found highly susceptible (HS).

Disease rating scale	Reaction	Name of variety	No. of varieties
0	HR	-	-
1	R	17256, 10139, 19308, 19299 and 18282	5
2	MR	18277, 191313 and 19309	3
3	MS	Rio grande, AT1811 and 19297	3
4	S	Nagina and 17257	2
5	HS	Nadir and Naqeeb	2

- **Diego *et al* 2011**

Management of CMV in chilli by using systemic resistance inducer chemicals

- DESIGN: RCBD
- P×P: 20 CM
- R×R: 60 CM

- Losses: 44.7%

  (Iqbal *et al*., 2012)
- APPLICATION OF RESISTANCE INDUCERS WITH DIFFERENT CONCENTRATION IN THREE REPLICATIONS
- Disease incidence was calculated with following formula:

% Disease Incidence = No. of Infected Plants x 100

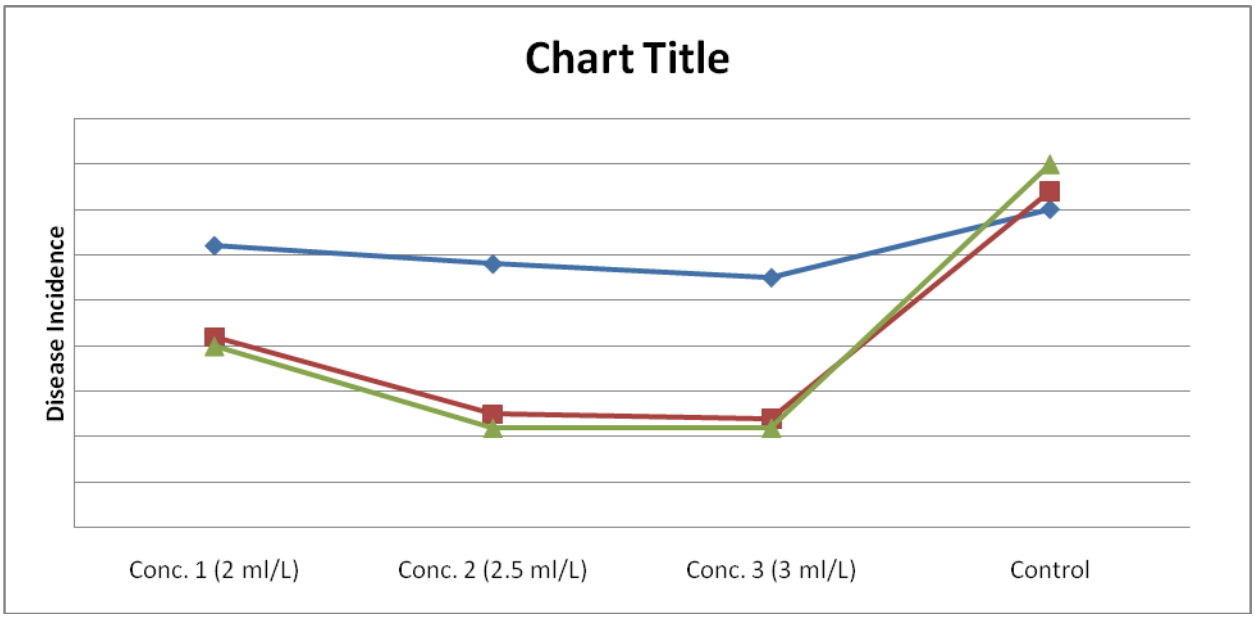
Total No. of Plants

(L-P-AWASTHI & P-KUMAR., 2008)

- Resistance inducer plant hormones and N,P,K (soln.) will be used to test their antiviral potential
- Three foliar sprays with different concentrations
- 1st spray before flowering
- 2nd and 3rd after 15 days of interval
- Data was recorded on weekly basis

Treatments	**Dose**
T1 = Salicylic Acid	1.5 %
T2 = Salicylic Acid + NPK	(1 % + 5ml)
T3 = KH2PO4 + NPK	(1 % + 5ml)
T4 = Proteoglycane	2ml/L
T5 = Control	Distilled water

Test entry Sanam was treated with Mashroom extract + Micro nutrients. Foliar application was completed three times with the interval of 15 days. First spray was completed before flowering. Data was recorded weekly intervals and results were compiled as:



Graphical representation of disease incidence and effect of three different concentrations of extract

Graph shows that 2nd concentration has significant impact on disease management.

Induced systemic resistance in okra against okra leaf curl virus using plant growth promoting rhizobacteria (PGPR)

Design: CRD

Nature of experiment: POT EXPERIMENT

Losses: 26-55%

(Tiendrebeogo *et al*., 2010)

Seed treatment of PGPR was done by mixing it in sugar solution. Three consecutivefFoliar spray of PGPR metabolites were completed after 15 days of interval. Plants were Inoculated with sap of infected plants. Data was recorded on weekly basis.

Disease incidence will be calculated with following formula:

$$\% \text{ Disease Incidence} = \frac{\text{No. of Infected Plants}}{\text{Total No. of Plants}} \times 100$$

(L-P-AWASTHI & P-KUMAR., 2008)

To check the impact of PGPR's on disease, **1** test entry Sabz pari was sown and 6 different treatments were applied as seed treatment, soil mixing and foliar sprays of metabolites.

Results showed that *Rhizobium* gave the significant results with only 17% disease incidence over the virus followed by *Psedumonas* (21%), *Bacillus* (25%), *Azotobactor* (33%) and *Azospirillum* (38%) as compared to control (45 %).

50. EVALUATION OF DIFFERENT CITRUS PLANTS AGAINST CITRUS TRISTIZA CLOSTEROVIRUS (CTV)

Samples were collected from different locations. Data pertaining to variety, plant health/establishment fertilizer application and GPS coordinates will be recorded. DAS-ELISA was performed in the serological laboratory of Plant Virology. Total 1200 citrus leaf samples were collected from Sargodha, Faisalabad and T.T.Sing from which 98% samples

were fit and 2% were infected with CTV.

Total samples =1200 Infected = 24				
Sargodha, Faisalabad and T.T.Sing				
Sr. No	**Variety**	**No. of Plants**	**Age of tree**	**CTV infected Plants**
1	Variable	1200	Nursery	24
Total samples: 1200, Infected 24				

51. EVALUATION OF MUNGBEAN VARIETIES/ LINES AGAINST MUNGBEAN YELLOW MOSIAC VIRUS (MYMV).

The breeding material will be collected from Pulses Research Institute, Faisalabad and will be sown in the research area of Plant Virology. Data on incidence of mung bean yellow mosaic virus disease of mung bean will be recorded before and after Pod development, pod setting stage and at pod maturity according to disease-rating scale developed by Bashir, 2005 Arbitary scale**.** The promising lines found resistant/tolerant will be utilized in breeding programme.

Mungbean Germplasm			
Sr. No.		**Variety/ Line**	**Total**
1	R=0-20	Lno 10-71, NM 6, Lno 54 NM 4, E 136, 6163-B-4, E-39, NL-31, E-86, 97001, Lno. 168, L No. 11, Lno. 103, LA 10-27, Lno 10-71, 97-12, 98009, 6601-A, LNo. 167, Lno. 107, BR NM 14, M-002, E-28-1, RC-63, 6368-40-404, LNo77, LNo166, LNo29, C2-94-3-11, 230-27-680-4, 11-2, KARK-1, V-6059-228, Lno 10-76, E 182-1, L.No-168, L.No-127, 632-72, AUMG-9801, M.003, E-112-1, L.N-10-10, E-96, LA-10-27, 4506, KARK-2, 121-121-25, L No. 162-B, M-005, Lno. 7-1, A-8, 6133538-4, L.No. 161, 97007, NM-51, 6149-5-12, , L.No.207, S-907, 97011, 98006, 4C MG-516, E-235	87
2	MR=21-40	E-86, RAMZAN, TM-1426, L No.7-1, TM-1428, 09TM-11, AUSTRILA, NM 54, , LNo 303, M-19-19, LNo3, NM 28, NM 98, NIFA-5 NM-12, L.No-10-39, L.no 120, L.no 37, NM-1, M.303, 632-72, 0173-4-10, NM-92, 1977, , NM-14, L.No-177, E-33, NIFA-2, 97017, M-001, NM-114, NM-10, NM-28, L.No. 7, C2-94-4-36, L.No. 162-13, 0173-4-10, NM 2011, No.162-163.	50
3	MS=41-60	Lno. 101, NM-92-17, 94-4-36, L No. 138, NM-92,	5
4	S=61-80	Nil	Nil

5	HS=81-100	Nil	Nil
	Total		145

52 EVALUATION OF URDBEAN VARIETIES/LINES AGAINST URDBEAN LEAF CRINKLE VIRUS (ULCV).

The breeding material will be collected from Pulses Research Institute, Faisalabad and will be sown in the research area of Plant Virology. Data on incidence of urdbean leaf crinkle virus will be recorded before and after Pod development, pod setting stage and at pod maturity according to disease-rating scale developed by Bashir, 2005 Arbitary scal.

The promising lines found resistant/tolerant will be utilized in breeding programme.

Urdbean Germplasm			
Sr. No.		**Variety/ Line**	**Total**
1	R=0-20	636475, 214337, 214338, 250163, 269526, 271410, 298919, 370640, 370641, 370642, 374163, 373137, 377364,377366, 377368, 377369m 377371, 377372, 377373, 37737, 377375, 377377, 377379, 377380, 377381, 377387, 377388, 377389, AARIM 26, 377405, 377406, AARIM 28, AARIM 30, AARIM 31, AARIM 34, AARIM 41, AARIM 54, AARIM 174, AARIM 176, AARIM 231, AARIM 240, AARIM 257, AARIM 263,	46
2	MR=21-40	AARIM 42, AARIM 36, AARIM 263, AARIM 269, 6065-5, 377404, 377405,	7
3	MS=41-60	323294, 377390, 323296, 323301, 323302, 377382, 377383, 377384, 377392, 377393, 377403, 377404,	17
4	S=61-80	NIL	NIL
5	HS=81-100	NIL	NIL
6	Total		70

53. Training In Field And Laboratory Identification And Integrated Management Strategy For Major Crops Insect Pests, Diseases And Weeds

107 Personnel from Agricultural Extension, Pest Warning and Quality Control of Pesticides and other stake holder were trained in identification technique and there integrated management for major crops with special emphasis on Insect Pest , Diseases and Weeds Control.