بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِيْمِ

ANNUAL REPORT 2021-2022

Mango Research Institute Multan

CONTENTS

MANGO RESEARCH INSTITUTE, MULTAN

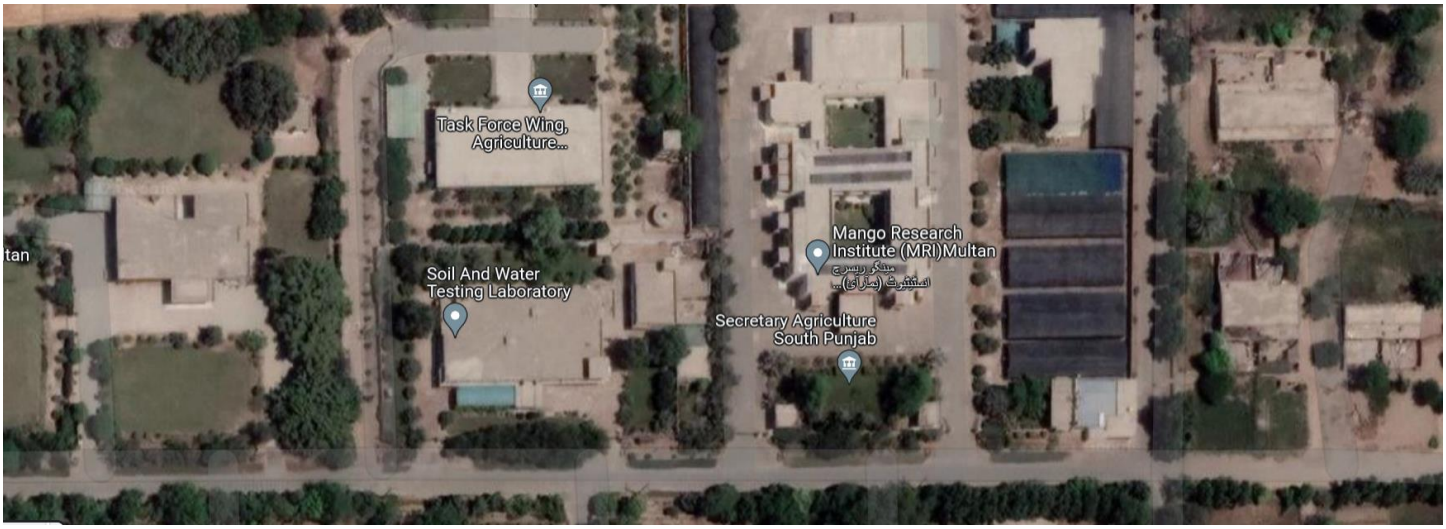
Abdul Ghaffar Grewal
Principal Scientist
Tel : +92-61-4423535
Cell:+92-321-7323945
Email: mrimultan@yahoo.com

1. OVERVIEW OF MANGO RESEARCH INSTITUTE, MULTAN

Mango (*Mangiferaindica* L.) has prominent position among fresh fruit commodity in export, cultivated in Pakistan on an area of 158.65 thousand hectares generated annual production 1722 thousand tons and productivity as 10.85 ton/hectare. Mango exportable quality is only produced at the farm level which is result of yearly hectic efforts to look after the mango trees according to its typical phenology. In Pakistan, there is dire need to streamline the entire mango industry stakeholders in Academia, Research, Extension, Pesticide, Fertilizer and Nurserymen should work in amalgation as a mango consortium. The technical facilities and knowledge can be utilized in its best way to strengthen our mango sector. A healthy mango orchard is imperative to attain the quality production peak, but without a healthy nursery plant, it will never be accomplished. Govt of the Punjab is subsidizing in nursery sector and mango nursery program is running under the auspices of this institute. Federal Seed Certification and Registration Department, Islamabad is also part to propagate the certified mango varieties and nurseries business can be legalized under seed act, 1975 amended in 2015. This institute has the task for capacity building of mango growers and extension staff in various districts of Punjab. It is pertinent to mentioned that online business in mangoes has been rapidly increased from a last couple of years and growers are very conscious about fruit size, sorting and quality due to its business existence, as good quality is appreciated and bad received the complaint as feedback. So due to this concept grower is attached to the institute for its quality mango fruit production keenly. This research institute has demonstrated and disseminated the medium density mango groves for the mango growers. But now a lot of work is being planned for the high and ultra-high density orcharding. Hence, it is quite easy to say that potential of the mango orchards may also be enhanced by adoption of good agricultural practices.

2. Geographic Location:

- Mango Research institute located at old Shujabad Road near the hub of agricultural complex viz., Cotton Research Institute, Soil Fertility, Pesticide Quality control, Agricultural Extension, Agricultural Crop Reporting, Floriculture and Secretariat Agriculture South Punjab Multan. MRI is a unique institute to guide mango growers through modern production technology and precise cultivation of new profitable mango varieties.
- Mango Research Institute, guides the farmers through the popular Urdu articles, farmer gatherings, radio and TV talks, and training programs including trainings of industry stakeholder.
- This institute also provides the true to type and clean mango nursery plants to the mango growers.



3. Area and production of Mango in Punjab

Table 3.1 Area, Production and Yield of Mango Growing Cluster Districts of Punjab, during 2014

Cluster	Area (ha)	Share (%) in provincial area	Production (tonnes)	Share (%) in provincial production	Yield (tonne/ha)
PUNJAB					
Multan	31,241	29.1	425,303	34.0	13.61
R Y Khan	24,384	22.7	226,560	18.1	9.29
M Garh	19,040	17.8	232,704	18.6	12.22
Khandwa	13,759	12.8	175,127	14.0	12.73
Cluster Total	95,283	88.9	1,059,693	84.6	11.12
Provincial Total	107,238	100.0	1,252,000	100.0	11.67

Source:
Cluster development based agriculture transformation plan vision-2025, Published in 2020. Planning Commission of Pakistan, Ministry of Planning, Development & Special Initiatives

4. Objectives

Mango Research Institute, Multan was established as an ADP scheme in January, 2012 and its gestation period was extended up to June, 2014 for completion of its target as mentioned in the approved PC-1 of this institute. Afterword, it may proceed towards the regularization. This institute was established especially for mango to work with all allied sections under one umbrella for the betterment of mango industry in the country. This institute comprises of following sections Horticulture, Plant Pathology, Entomology, Plant Nutrition and Postharvest, working under the leadership of Director, Mango Research Institute Multan. It is pertinent to mention here that before the establishment of this institute at Multan, Mango Research Station Shujabad has been working at Shujabad since 1976. Now Mango Research Station Shujabad is a sub-station of this institute.

Horticulture Section

- Introduction of new mango varieties (Early, Mid and Late) through research and development to expand the market window
- Transfer of standardized technology to farmers, exporters, extension workers, nursery man, and other stake holders.
- Evaluation and establishment of germplasm unit for conservation and distribution of bud wood to the stakeholders.
- Evaluation of homogeneous rootstock (Polyembryonic) for mango industry of the country, useful against different abiotic stresses.
- Screening of stable media ingredients in suitable combination to optimize the nutritional and irrigation requirements for the production of clean & healthy potted Mango nursery plants.
- Production of true to type clean & healthy potted Mango nursery plant and sale to the farmer on subsides rate.
- Evaluation of appropriate planting geometry for “small tree system" in Mango.
- To evaluate commercially viable pre and postharvest technologies for delivering quality produce in domestic and export markets

Plant Pathology Section

- To find out Integrated management strategies for mango diseases
- To assess new diseases in mango region
- To conduct lab analysis of unusual diseased samples
- To find out the impact of Environmental variables on the incidence of mango diseases
- To create awareness among mango growers about IDM

Entomology Section

- Insect pest management with minimum use of chemicals/insecticides
- Identification of new emerging insect pest of mango
- Monitoring the insect pest population on new promising mango strains
- Development of insect pest management strategies keeping in view the social, ecological and economic consequences.
- Identification of biological controlling agents against different insect’s pests.

Post-Harvest Section

- To standardize technology for fruit harvesting, post-harvest handling, packing, storage and enhancement in shelf life for its shipment to distant markets of the world.

Plant Nutrition Section

- To work out nutrient response and formulate economic fertilizers recommendation via adapting integrated plant nutrition system
- To find appropriate time and method of fertilizer application
- To correlate mango response with soil test value of different nutrients
- To develop technology for ameliorate of salinity and sodicity minus by the use of amendments.
- To determine the plant growth regulators on mango growth and yield

5. Horticulture Section

5.1 Survey for the collection of promising mango Strains

The experiment was long term nature with an objective to select promising mango strains after local collections identified from grower's orchard & exhibitions. Survey was carried out in different mango regions and fruits of promising strains were collected. Quality attributes were assessed at MRI, Multan on the basis of evaluation criteria finalized by evaluation committee. The strains showed significant behavior were remained under close observation of researchers to explore its characteristics and bud wood of selected strains was also collected and multiplied in sectional mango nursery for further evaluation. Strains which couldn't fulfill the selection criteria were discarded after evaluation. Quality characteristics of identified mango collections are given as in Table 1 as well as (Fig. 1).

Table 1. Data profile of collected mango strains.

Strains identified	Fruit weight (g)	Peel weight (g)	Stone weight (g)	Pulp ratio (%)	TSS (Brix)
PREVIOUS COLLECTIONS					
Sandeela	310	39	51	70.96	18.7
Haseen	379	44	56	73.61	21.9
SP	531	92	65	70.43	21.01
Pink Chaunsa	449	40	49	80.17	19.1
NEW COLLECTIONS					
Suraj Miani – 1	347	47	43	74.1	27.1
Kot Addu -1	320	62	42	66	20.8
Ghulam Rasool Wala	167	28	30	65.27	21.7

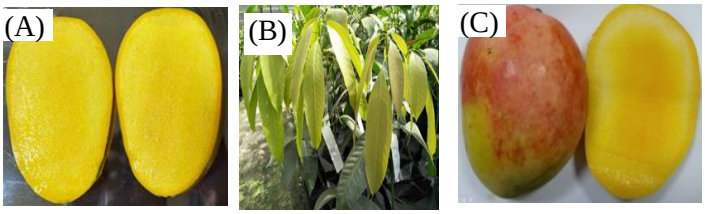


Fig.1. (left to right) SP fruit (A) Pink Chaunsa (B) and SP grafted plants at MRI (C).

5.2 Effect of different growth stimulants on health and vigour of mango nursery plants

This experiment was conducted to check the efficacy of different growth stimulants in enhancing the growth of nursery plants and to make them graftable within duration of less than one year. Experiment was conducted at Mango Tunnel Nursery, MRI, Multan, according to Completely Randomized Design (CRD) with 05 treatments with three replicates. Foliar application of different growth biostimulents i.e. Wokozim, Harmonic Super, Kamab -26 and Gibberex was done on nursery plants to enhance the vegetative growth under tunnel conditions. Performance of nursery plants was evaluated on the basis of plant height, Number of flushes/plant and stem girth.

It was observed that stem girth was significantly increased by the application of Wokozim (seaweed extract) (Table 5). Stem girth of the mango plants treated with Wokozim and Kamab-26 was at par to each other. Maximum plant height was recorded by the application of Wokozim followed by Kamab-26 (130 cm), when compared with control treatment.

Table 2. Effect of different growth stimulants on health and vigour of mango nursery plants.

Treatments	Plant height (cm)	Stem girth (cm)	No. of flushes /plant	No. of leaves /plant
T_1 (Wokozim)	131	0.87	7	39
T_2 (Harmonic Super)	117	0.78	6	37
T_3 (Kamab-26)	130	0.87	7	38
T_4 (Gibrex)	97	0.68	5	30
T_5 (Control)	94	0.60	4	29

5.3 Effect of different chemicals in protection of mango seedlings/young plants from frost and cold weather injuries

50 healthy and small mango plants under each treatment were selected on three locations. Four locally available chemicals were tested to ascertain the manufacturer's claim and the products' efficacy against frost. The name of the chemicals were: Kama-26(T1), Green Polish (T2), Neu-Therm (T3), and No-Frost (T4).

Fig 2. (Left to Right) (A) Chemicals, (B) Spray of Chmeicals (C) Plant affected by frost

The 1st foliar spray of the aforementioned chemicals was applied during 2nd week of December. Similarly, second spray was applied in 1st week of January. The symptoms of frost bites were recorded on buds, leaves, beanches and mortality was also recorded. According to the data, No-Frost (T4) privided the best defense mechanism against frost, however the results were not that significant due to less damage on all plants. Similarly, an interesting phenomenon was obsereved in T1 (Kamab-26) where the plants under the treatments flowered profusely along with heavy vegetative growth on non-flowering plants.

5.4 Development of new mango varieties through chance seedling of promising mango cultivars:

The experiment was conducted to shorten the varietal development period of mango and to produce new mango varieties through grafting of scion wood of chance seedling of promising mango cultivars. Total 150 stones of three commercial mango cultivars viz., Sindhri, SB Chaunsa and White Chaunsa, 50 stones of each variety were collected from the outer periphery of different orchards. The collected mango stones were soaked in fresh water for 48-72 hours and then these mango stones were sown in bagasse for germination in the lath house/ semi shade conditions at Mango Research Institute, Multan. After germination, healthy and vigorous growth showing 150 seedling plants (50 each variety) were transplanted in the polythene bags of 10x14 inches size. The present data regarding vegetative growth is given in Table 3. Further, these seedling plants at the age of one year having suitable plant height (3-4 feet) will be transplanted in the field at a distance of 5 feet and each plant will be allotted an accession number. After the transplanting of seedling plant in field and spending another year in field conditions, mature scion woods capable of grafting from these saplings will be collected and grafted on a branch of established mango trees and tagged. These grafted scion woods will be encouraged for vegetative and reproductive growth. Fruit quality parameters will be checked on fruit setting from each scion wood (accession). The accession having desirable characteristic will be further studied and evaluated with permission of evaluation committee, while the rest of the accession will be discarded.

Table 3: Vegetative characteristics of selected seedlings/cultivars.

Cultivar	**Height (cm)**	**No. of Flush/Plant**	**Flush Length**	**No. of leaves/ Flush**
Sindhri	57cm	04	16 cm	05
SB Chaunsa	42 cm	03	12 cm	07
Sufaid Chaunsa	54 cm	03	15 cm	06

5.5 **Orchard intensification under different punning and training Systems to improve blooming and yield in mango:**

The experiment was initiated to explore suitable and appropriate orchard intensification system for commercial mango varieties with improved yield. Healthy grafted Mango Plants of each variety having of 2-3 Year age have been transplanted at distance of 15x10 feet during 2021-22 at experimental research farm of Mango

Research Institute, Multan. Tree plant size is being maintained as desired within rows and between rows to make hedge and 03 different system of pruning will be adopted for 03 commercial mango varieties. Irrigation and nutrition is being ensured to achieve vegetative growth of plants as early as possible after transplantation. After attaining the desired plant canopy in hedge the data will be recorded for postharvest growth, flowering and fruiting. The fruit production data will be calculated under each pruning and training system for each variety and fruit quality will be assessed by grading into A, B and C category. The criterion was A (Good size and Shape), B (Medium size and good shape), C (Small size and de-shaped). The number of flowering panicles and fruit yield data and following other parameters will be recorded for 2-3 years in all treatment and will be compared with control. On the basis of observations and data recorded, the most suitable tree training system for each commercial mango variety will be recommended for high quality fruit production for small plants. This experiment was of continued nature, major plantation of desired varieties has been achieved and further data will be recorded on attaining the desired plant height.

6. Plant Nutrition Section

6.1 Evaluation of trench technology as a solution of mango dieback problem in Multan

A study was planned to assess the physical and chemical changes occurring in trenches supposed to be responsible. Soil samples were collected under canopy of the following plants of 4 treatments viz., Untreated plants, Trenches aged 1 year, Trenches aged 2 year, Trenches aged 4 year, with three repeats in RCBD lay out. Soil samples were collected from the trenches for deep profile study of physical and chemical parameters. EC of the untreated plant soil was highest (7.84 dSm^{-1}) whilst for trench with maximum age i.e. 4 years it remained lowest (1.21 dSm^{-1}). Similarly, 8.12 pH was obtained for plant soil without trenches and lowest 7.89 for plant soil with three year aged soil. The bulk density (0.930, 0.888) for non-trenched plant soil was higher than trenches aged 4 years respectively. More organic matter was found in soils with longest aged trenches (0.726, 0.873). Therefore. it was concluded that trenches had positive impact on physical and chemical properties of soil as well as plant response to soil conditions.

Fig 3. Soil sample collection and preparation for physical and chemical properties determination.

Table 4. Soil analyses for EC, pH and moisture contents for Oct- Dec 2021

Treatments	**Moisture Contents (%)**	**EC (1:100)**	**pH**
Untreated Plants	38	1.496	8.11
Trench established up to 1 year	38	1.24	8.15
Trench established up to 2 year	37	1.316	8.07
Trench established up to 3 year	37	1.023	7.90
2^{nd} sampling			
Untreated Plants	39	1.44	8.12
Trench established up to 1 year	38	1.25	8.16
Trench established up to 2 year	36	1.29	8.10
Trench established up to 3 year	35	1.03	8.02
3^{rd} sampling			
Untreated Plants	37	1.45	8.11
Trench established up to 1 year	37	1.23	8.15
Trench established up to 2 year	35	1.28	8.09
Trench established up to 3 year	35	1.04	8.01
4^{th} sampling			
Untreated Plants	36	1.44	8.10
Trench established up to 1 year	36	1.22	8.15
Trench established up to 2 year	34	1.28	8.06
Trench established up to 3 year	33	1.03	8.00
5^{th} sampling			
Untreated Plants	35	1.43	8.09
Trench established up to 1 year	34	1.21	8.14
Trench established up to 2 year	33	1.27	8.06
Trench established up to 3 year	33	1.01	8.00

Soil samples were collectted and analyzed for moisture percentage in samples, EC and pH. The trenches with maximum age showed better performance in above three parameters with respect to plant response.

Table 5. Soil analyses for EC, pH and moisture contents for Jan- Mar 2022

Treatments	Moisture Contents (%)	EC (1:100)	pH
Untreated Plants	34	1399	7.88
Trench established up to 1 year	32	268.2	8.12
Trench established up to 2 year	36	588	7.93
Trench established up to 3 year	34	148.9	8.08
2^{nd} sampling			
Untreated Plants	37	196.5	8.13
Trench established up to 1 year	36	176.9	8.12
Trench established up to 2 year	36	756	8.19
Trench established up to 3 year	38	231.3	8.03
3^{rd} sampling			
Untreated Plants	36	1399	7.88
Trench established up to 1 year	34	268.9	8.12

Trench established up to 2 year	36	588	7.93
Trench established up to 3 year	32	148.9	8.08
4th sampling			
Untreated Plants	36	196.5	7.96
Trench established up to 1 year	36	176.9	7.95
Trench established up to 2 year	34	756	7.58
Trench established up to 3 year	33	231.2	8.00
5th sampling			
Untreated Plants	36	143.4	8.19
Trench established up to 1 year	35	161.1	8.11
Trench established up to 2 year	37	195.2	7.76
Trench established up to 3 year	38	228.1	8.09

For first sampling the trenches with 2 years age proved best for moisture contens and pH of soil. But lowest EC was recorded for trenches of three years age. For 2nd and 4th sampling lowest EC was recorded for 1 year aged trenches but 3 year age trenches were found best for miosture contents and pH of samples taken.

Table 6: Soil analyses for EC, pH and moisture contents for Apr-Jun 2022

Treatments	Moisture Contents (%)	EC (1:100)	pH
Untreated Plants	33	1364	8.01
Trench established up to 1 year	33	258.8	8.10
Trench established up to 2 year	35	591	7.99
Trench established up to 3 year	34	149.4	8.06
2nd sampling			
Untreated Plants	35	197.9	8.13
Trench established up to 1 year	35	178.8	8.10
Trench established up to 2 year	35	760	8.12
Trench established up to 3 year	37	233.7	8.01
3rd sampling			
Untreated Plants	35	1357	7.90
Trench established up to 1 year	35	269.5	8.10
Trench established up to 2 year	36	591	7.96
Trench established up to 3 year	36	149.4	8.06
4th sampling			
Untreated Plants	35	197.2	7.99
Trench established up to 1 year	34	175.3	7.98
Trench established up to 2 year	35	751	7.87
Trench established up to 3 year	34	223.4	8.01
5th sampling			
Untreated Plants	35	145.2	8.10
Trench established up to 1 year	35	162.5	8.09
Trench established up to 2 year	34	196.7	7.82
Trench established up to 3 year	35	225.9	8.02

The trenches with maximum age showed better performance in above three parameters with respect to plant response in this duration of sapmling.

6.2 Assessment of fruit quality determining nutrients in different mango cultivars at different locations

Plant nutrition is one of the most important factors affecting fruit development, quality and postharvest performance. The most important factor in postharvest quality is firmness, which can maintain fruit quality and prolong shelf life by increasing the fruit cell wall thickness or cell compactness. Boron, calcium, and magnesium may alter these properties. Therefore, initially a survey study was planned to collect fruits of five prominent cultivars i.e. Sufaid Chaunsa, Samar Bahisht Chaunsa, Sindhri, Azeem Chaunsa and Chenab Gold from three locations to determine the nutrient interactions involved in fruit quality determination. Sufficient level of N was found in all cultivars whereas P and K were found extremely deficient in all cultivars from all locations. The Ca, Mg and B analyses is in progress.

Table 7. Analyses of fruit samples of different cultivars for TSS and Acidity

Cultivars	Acidity (%)	TSS Brix°
Chenab Gold	0.38	20.9
Azeem Chaunsa	0.39	21.7
Sindhri	0.24	20.2
Sammar Bahisht Chaunsa	0.27	24.9
Sufaid Chaunsa	0.38	22.7

Table 8. Mean values of nutrients in fruit samples of different cultivars (NPK)

Cultivars	N	P	K
	(%)		
Chenab gold	1.20	0.13	0.39
Azeem chaunsa	0.97	0.14	0.43
Sindhri	0.83	0.09	0.53
Sammar Bahisht chaunsa	0.96	0.10	0.61
Sufaid chaunsa	0.75	0.14	0.52

Table 9. Mean values of nutrients in fruit samples of different cultivars (Ca, Mg, B)

Cultivars	Ca	Mg	B
	%		ppm
Chenab gold	0.08	5.00	10.76
Azeem chaunsa	0.07	4.00	11.19
Sindhri	0.07	6.00	12.32
Sammar Bahisht chaunsa	0.06	8.00	11.32
Sufaid chaunsa	0.06	7.00	12.56

Fig.4: Fruit sample analyses being conducted for TSS, acidity and potassium contents

6.3 Exploring the reasons of de-shape of fruit in mango cv. Sindhri at different locations

For the enhancement of Pakistan's competitiveness in the agriculture sector in national and international markets, in the most exportable commercial cultivar Sindhri was addressed in this study. To fill this gap an organized survey was conducted to study nutrient interactions involved in mango fruit quality (shape) and to investigate the soil moisture relations with fruit development. The study also aimed to cover a large area to record climate change impacts on fruit development. The results obtained for nutritional interactions for NPK concentration are as follows. The results are non-significant with each other emphasizing no specific interaction was found in samples collected from 3 locations.

Table 10. Mean values of nutrients in fruit samples of cv Sindhri (NPK)

Locations	N	P	K
	%		
Multan	1.09	0.028	0.39
Muzaffar Garh	0.97	0.029	0.47
Rahim yar khan	0.63	0.028	0.24

Table 11. Mean values of quality parameters (TSS and Acidity) in fruits of cv Sindhri

Locations	Acidity (%)	TSS Brix°
Multan	0.33	17.9
Muzaffar Garh	0.34	18.7
Rahim yar khan	0.35	19.2

Table 12. Mean values of nutrients in fruit samples of cv Sindhri (Ca, Mg, B)

Locations	Ca	Mg	B
	%		ppm
Multan	0.06	4.00	12.35

Muzaffar Garh	0.05	7.00	13.82
Rahim yar khan	0.06	8.00	13.12

Fig. 5: Fruit sample analyses being conducted for TSS, acidity and nitrogen contents

7.0 Plant Pathology Section

7.1 Assessment of post-harvest diseases in mango cv Chenab Gold & Azeem Chaunsa.

The fruits of mango Cvs. Chenab Gold and Azeem Chaunsa were harvested at their proper maturity adopting standardized procedure to estimate the post-harvest diseases at different storage intervals. The harvested fruits were stored at 10-12ºC and collected from the storage on weekly basis up to 4 weeks. After packing, collected fruits were kept in lab for ripening at almost 25ºC for 3-5 days. The direct ripening after harvest of fruits was kept as control treatment. After ripening, the incidence of post-harvest diseases like body rots and stem end rot was recorded. The disease intensity was also assessed just after ripening through adopting the respective rating scale of the disease. The appearance of other diseases and disorders after specific storage conditions was likewise recorded.

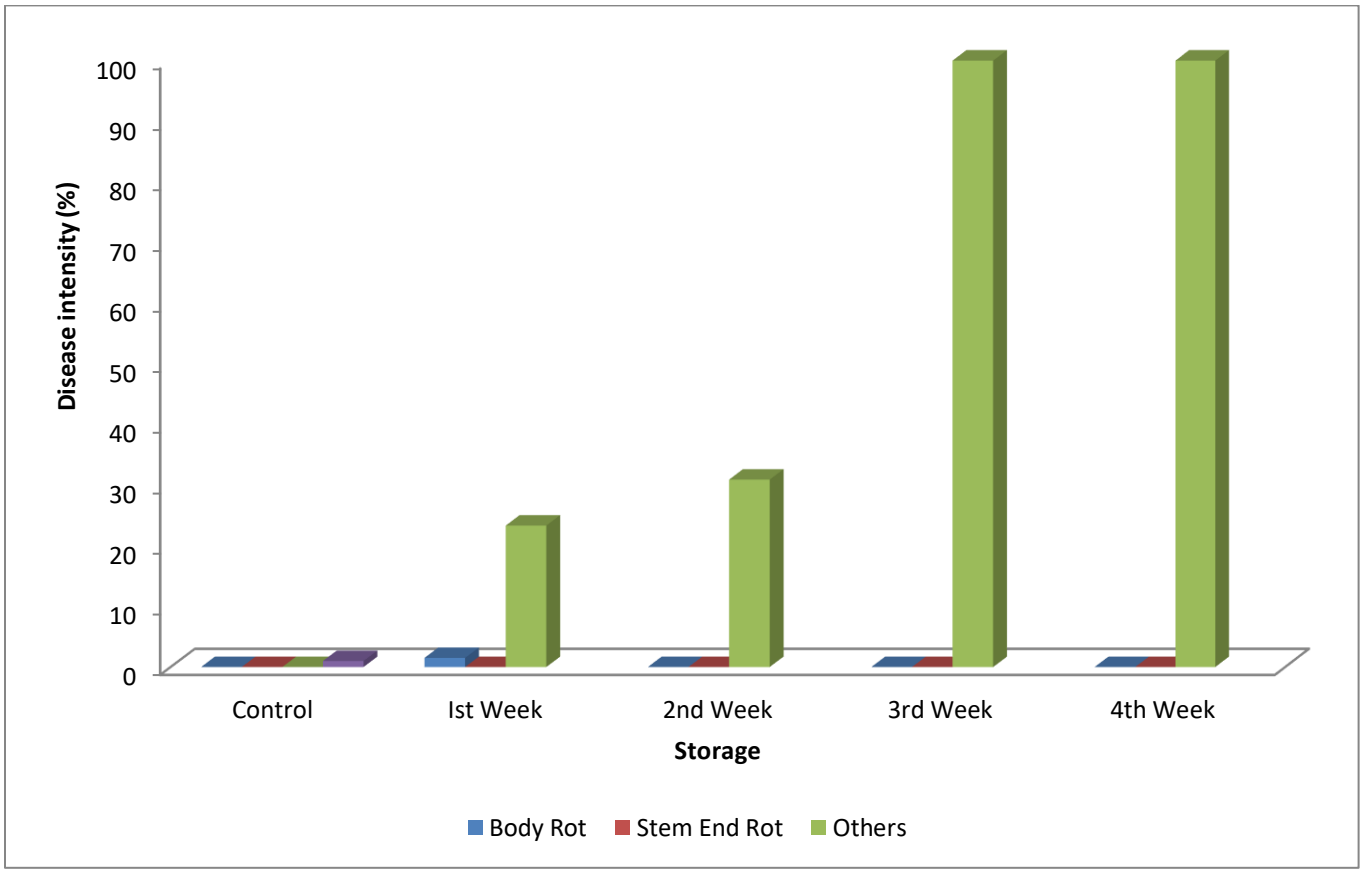


Fig 6 Intensity of post-harvest diseases on fruits of mango cultivar Chenab Gold after different storage intervals

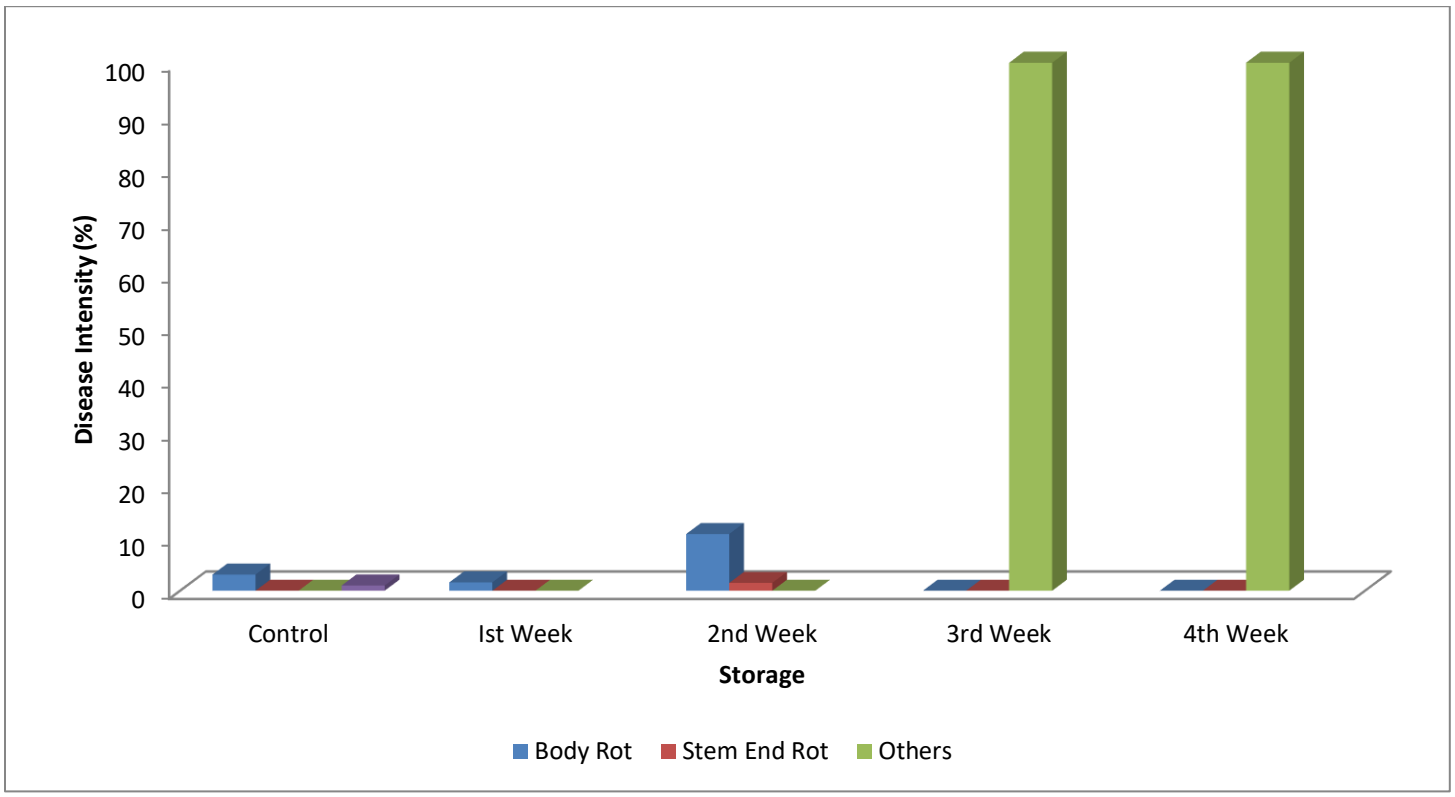


Fig 7 Intensity of post-harvest diseases on fruits of mango cultivar Chenab Gold after different storage intervals

No disease was recorded in control treatment after ripening of the fruits while body rot and other unidentified spots were conspicuous by 1.5 and 23.43 percent intensity in accordance on the fruits of Chenab Gold kept in storage for one week. Similarly, the intensity of these spots was recorded by 31.0% in storage two weeks. The fruits stored for 03 to 04 weeks entirely exhibited 100 percent intensity of the spots after ripening. On the other hand, the maximum intensity of unidentified spots was observed on the fruits of mango cv. Azeem Chaunsa by 100% in T3 and T4 followed by 10.5% of body rot noticed in T2. The fruits stored for one week showed minimum intensity of body rot by 1.6%. All the storage duration depicted the post-harvest diseases on the fruit of this variety including control treatment. The present study reveals that the incidence and intensity of post-harvest diseases on fruits in mango cultivar Chenab Gold and Azeem Chaunsa look very much correlated with storage duration but management and plant structure might be contributing factors which will be addressed in the next year.

7.2 In-vitro and in-vivo exploitation of *Trichoderma* spp as biological control agent against Mango Sudden Death disease (MSD).

For optimization, the conditions for the rapid multiplication of *Trichoderma* to combat mango sudden death disease (MSD) seedling mango were grown in poly ethylene bags having various media composition. Artificial inoculation was done by the application of aqueous suspension of *Ceratocystis* spp (Pathogenic fungus of MSD)

culture in the pot media of all plants including control treatment after making roots injured. Only the infested plants were kept for further study with the additional application of aqueous suspension of antagonistic fungus (*Trichoderma*). Nothing was applied to the plants kept as control. Conducive conditions like optimum aeration and moisture were maintained for the proliferation of *Trichoderma*, Disease symptoms mainly focusing on mortality of the plants were recorded.

Table 13. Different pot media compositions for the multiplication of antagonistic fungus (*Trichoderma* spp.)

Treatment	**Silt : Baggas: Coconut**	**Treatment**	**Silt : Baggas: Coconut**
T1	10-85-5	T6	60-35-5
T2	20-75-5	T7	70-25-5
T3	30-65-5	T8	80-15-5
T4	40-55-5	T9	90-5-5
T5	50-45-5	T10	100-0-5

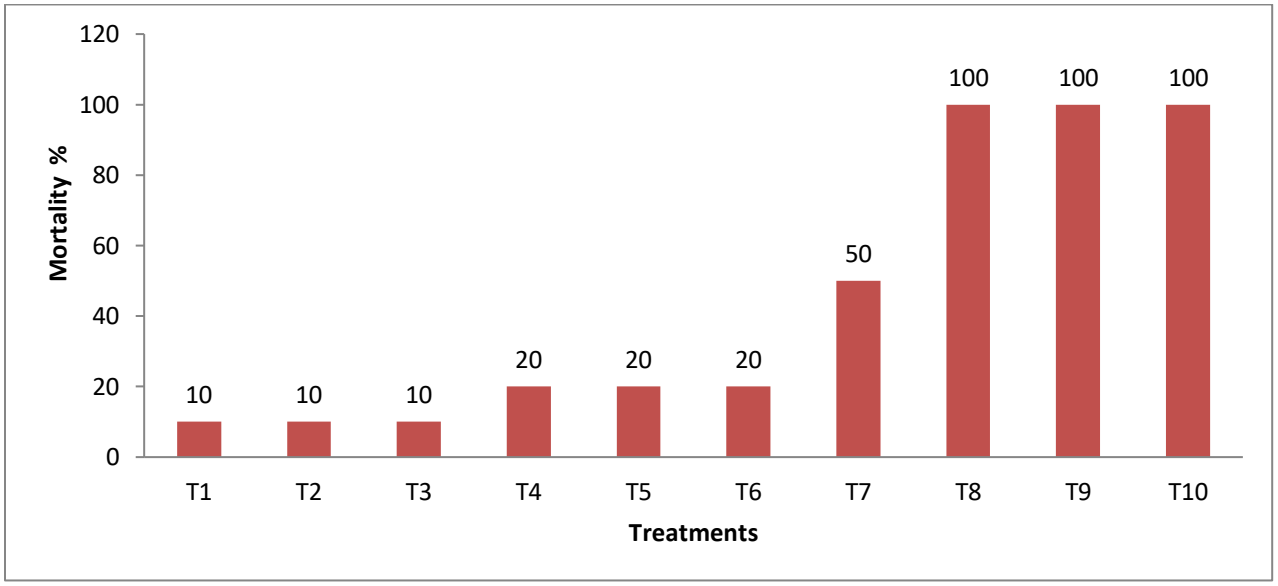


Fig 8: Effect of various treatments for *Trichoderma* proliferation.

The treatments (T_1 to T_6) having 10 to 60% proportion of silt in potting mix, showed 10 to 20% mortality in the experimental plants while, T_7 depicted 50% mortality. Maximum mortality by 100% was observed in T_8, T_9 and T_{10} where silt was added by 80, 90 and 100% proportion respectively. The preliminary probe in the study reveals that quantity of silt in pot media is a contributing factor for the multiplication of antagonistic fungus i.e *Trichoderma* as the proportion of silt increases the proliferation of *Trichoderma* decreases because of compaction

of silt creating the non-conducive conditions for an antagonistic fungus. It has been concluded that *Trichoderma* penetrate rapidly in porous media and vice versa.

7.3 Handling of post-harvest diseases of mango cv Sufaid Chaunsa by using disinfecting agents.

The experiment was conducted to check the efficacy of various treatments (Hydrogen per oxide, Accetic acid, Postassium meta bisulphate) on the incidence of postharvest diseases on cultivar Sufaid Chausa. The fruits were harvested from orchard of Mango Germplas Unit, Khanewal and brought to Plant Protection Lab. The fruits were treated by dipping for 30 minutes in the following solutions: -

Treatment	
T_1	H_2O_2 (2%)
T_2	H_2O_2 (1%)
T_3	Potassium metabi sulpahte (1%)
T_4	Potassium metabi sulpahte (2%)
T_5	Acetic acid (3%)
T_6	Acetic acid (2%)
T_7	Control

After treatment, the fruits were air dried and kept in boxes for ripening. The incidence of post-harvest disease after ripening was recorded by using following formula:-

$$\text{Disease Incidence (DI)} = \frac{\text{Number of infected fruits}}{\text{Total number of assessed fruits}} \times 100$$

Table 13: Effect of disinfecting agents against post-harvest diseases of mango.

Treatment	**Disease Incidence (%)**			**Disease Severity (%)**
	Stem End Rot	**Body Rot**	**Others**	
T_1	0	20	0	5
T_2	0	30	0	7.5
T_3	0	20	0	5

T_4	0	30	0	7.5
T_5	0	20	0	10
T_6	0	40	0	15
Control	30	50	0	42.5

pics

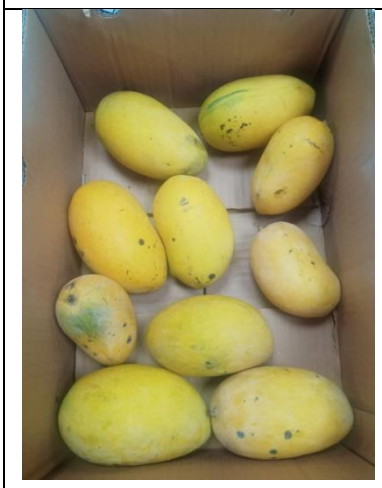
T1	**T2**	**T3**
		
T4	T5	T6
		
Control		

Fig 9.

The results revealed that minimum disease incidence (20%) and severity (5%) of body rot was observed on fruits treated with T_1 and T_3. Maximum disease incidence and severity on control was (50% & 42.5%) respectively. The stem end rot incidence of 30% was observed on fruits of control treatment.

7.4 Assessment of flower diseases on commercial mango varieties under variable management conditions.

The experiment was conducted to observe the incidence of floral diseases i.e Blossom Blight, Powdery mildew, Apical Necrosis and mango malformation from January to April in Multan, Muzaffargarh and Khanewal. Medium sized healthy plants were selected and observation was made on 10 spots on each experimental tree using ring method. The data regarding management practice (Nutrition, irrigation, pruning, plant protection) were also recorded in each location. The meteorological data regarding thermal regime & relative humidity was also recorded from Central Cotton Research Institute, Multan.

Table 14: Assessment of floral diseases on different varieties and locations.

MRI, Multan

Variety	**Disease Incidence (%)**			
	Blossom Blight	**P. mildew**	**A. Necrosis**	**MMD (panicles / tree)**
Dusehri	0	40	0	12
Sindhri	0	0	0	0
S.B. Chaunsa	0	0	0	60
Sufaid Chaunsa	0	30	0	34

M.Garh- KotAdu

Variety	Disease Incidence (%)			
	Blossom Blight	P.Mildew	A.Necrosis	MMD(panicles / tree)
Dusehri	0	10	0	15
Sindhri	0	0	0	10
S.B. Chaunsa	0	0	0	25
Sufaid Chaunsa	0	0	0	30
Retaul Late				

M.Garh- Khangarh

Variety	Disease Incidence (%)			
	Blossom Blight	P.Mildew	A.Necrosis	MMD(panicles / tree)
Dusehri	0	10	0	20
Sindhri	0	0	0	15
S.B. Chaunsa	0	0	0	27
Sufaid Chaunsa	0	0	10	32

GPU-Khanewal

Variety	Disease Incidence (%)			
	Blossom Blight	P.Mildew	A.Necrosis	MMD(panicles / tree)
Dusehri	0	0	0	15
Sindhri	0	0	0	20
S.B. Chaunsa	0	0	0	30
Sufaid Chaunsa	0	0	0	32

The result revealed that maximum disease incidence (40%) of powdery mildew was recorded followed by apical necrosis (10%). No incidence of blossom blight was noticed. Apical Necrosis incidence observed in Khangarh Muzaffargarh was 10%. Among the varieties, maximum incidence of powdery mildew was noted on Dusehri followed by Sufaid Chaunsa in the orchard of Multan. Mango Malformation disease was observed on all the varieties in all the districts under study with minimum incidence on Sindhri.

7.5 Chemical treatment of mango plants infected with sudden death disease under different conditions.

For the efficacy determination of Macro Infusion System (MIS) under different field conditions and severity levels of mango sudden death disease (MSD), the mango plants under following treatments were injected with Thiophanate methyl @ 8 g/lit twice after 15 days interval.

Treatment	Description	No. of plants	Disease rating scale before treatment
T_1	Plants with initial symptoms	6	0-2
T_2	Plants adjacent to initial symptoms	2	0
T_3	Plants with advanced symptoms	6	0-3
T_4	Plants adjacent to advanced symptoms	45	0

The disease on mango trees was estimated on the basis of symptoms severity. Symptoms such as rotting, blackening and cankers at the collar region and crown roots were assessed as major but latent symptoms such as gummosis, on the main trunk and curling, drying and shedding of leaves and wilting tree were observed as major and apparent symptoms for disease measurement. A total of 20 branches on each experimental tree were selected in four directions. The branches showing gummosis were labeled and tagged for disease assessment. Data were collected before and after treatment. The formula for the calculation of disease severity used is given below:

$$\text{Disease Severity (DI)} = \frac{\text{Sum of numerical ratings on the whole tree}}{\text{Total numbers of assessed branches X Max disease rating scale}} \times 100$$

The disease rating scale was rated as follows:

0	No disease
1	Slightly infection on branches and curling of leaves
2	Mild infection on branches and dead leaves but attached.
3	High infection on branches and defoliation of leaves

Disease decrease percentage of MSD after treatment of plants with fungicide through MIS.

Table 15: Disease decrease percentage of MSD after treatment of plants with fungicide through MIS

Treatment	**Disease Severity before treatment (%)**	**Disease severity after treatment (%)**	**Disease decrease (%)**
T_1	22.22	15.27	31
T_2	0.0	0.0	0
T_3	38.88	27.77	29.0
T_4	0.0	0.0	0

The plants showing the disease severity level from 0-2 reflected the good response to the treatment of fungicide through injection of MIS by 31% disease decrease. While the plants with 0-3 disease rating scale showed the recovery by 29%. The fungicide injection of Thiophanate methyl through MIS worked effectively to rejuvenate MSD infected plants. Further it also prevented the adjacent plants apparently showing no symptoms before and after treatment.

8 Entomology Section

8.1 Comparative effectiveness of different insecticides against mango fruit borer

Experiment was conducted in the orchard of Mango Germ Plasm Unit, Khanewal to determine the effectiveness of different insecticides against mango fruit borer. The experimental treatments were T1 (Flubendiamide (Belt 480 SC) @ 25ml/100L water), T2 (Gamma cyhalothrin + chlorpyriphos (Bolton 31EC) @ 150ml/100 L water), T3 (Emmamectin benzoate (Timer 1.9 EC) @ 200ml/100 L water), T4 (Chlorantraniliprol (Coragen 20 SC) @ 50 ml/100 L water and control. The experiment was conducted on most sensitive variety Sindhri keeping 5 plants as experimental unit. Overall, the minimum damage percentage of clusters (5.95%) by mango borer was observed in treatment having spray of Coragen followed by Belt (10.32%) Timer (13.49%) and Boltan (23.41%). The maximum damage percentage of clusters was found (32.14%) in case of Control where no insecticidal spray was done.

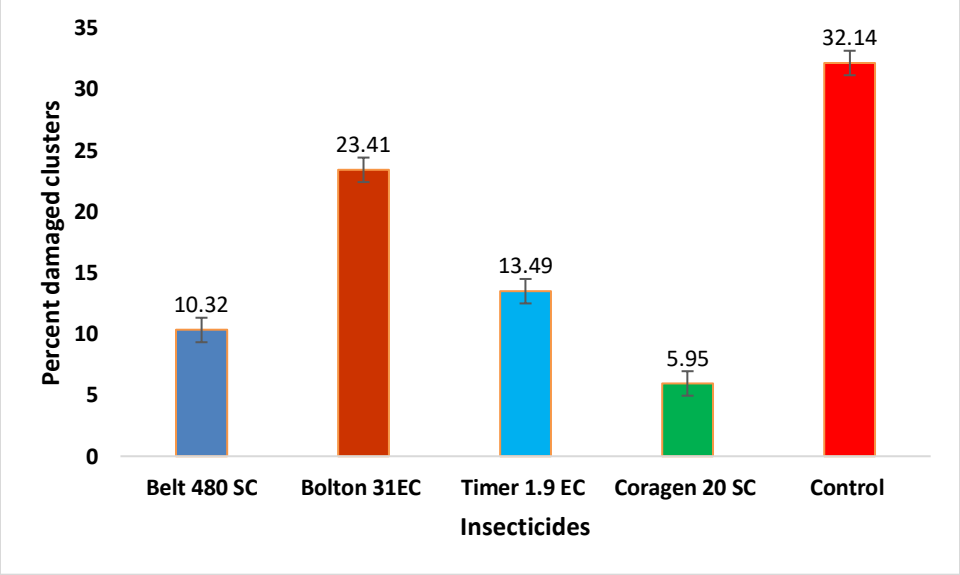


Fig. 10: Comparative efficacy of various insecticides against mango fruit borer.

8.2 Effectiveness of various botanical extracts against mango hopper and thrips

The experiment was conducted to explore the efficacy of plant botanical extracts against hopper and thrips. Three 03 kg leaves of each plant was frozen and crushed plant extractor. Then from this extract, 5% solution was prepared and sprayed on experimental trees. Korhtuma fruits shake was prepared by grinding 1.5 kg fruits in 250ml water. After sieving this extract, 5% solution was prepared and then sprayed on experimental trees. One hundred gram (100g) tobacco were soaked in 03 L water followed by boiling. On cooling, sieving of this solution will be done and 3% solution of that material will be prepared and sprayed on experimental trees. The experiment consisted of 16 treatments.

The population of mango hopper/ inflorescence was recorded by observing 5 inflorescences of each treated plant. The population of mango hopper was counted by beat and bush method using plastic tray lined with white paper. Each inflorescence was tagged after every observation so that it may not be included in further data record. The data of pest population was recorded before spray and then 1, 3, 5 and 7 days after spray. Percent mortality of mango hopper was calculated using formula.

$$= \frac{\text{Population before spray} - \text{Population after spray}}{\text{Population before spray}} \times 100$$

Mango Thrips: The population of mango thrips was recorded during the month of March-April by observing 20 leaves of new flushes of each experimental plant. The botanical extracts were sprayed when the population of mango thrips will be at ETL i.e 5 thrips/leaf. Observations were recorded before spray of botanicals and then 1, 3, 5 and 7 days after spray. Percentage mortality was calculated for each treatment.

Table 16: Comparative effect of various botanical extracts in population suppression of mango thrips.

Treatment	Plant Extract	BS	24 hrs	72 hrs	5 days	7 days
T1	Neem	9.65	4	0.3	0.3	0.1
T2	Dhatura	12.6	5.1	1	0.35	0.15
T3	Tobacco	0.1	0	0	0.2	0
T4	Ak	1.25	0.85	0	0.3	0.1
T5	Korhtuma	10.55	3.2	0.8	0.2	0
T6	Neem + Dhatura	2	0.95	0.55	1.05	1.1
T7	Neem + Tobacco	2.45	1.7	1.2	1.25	0.85
T8	Neem + Ak	3.35	1.5	0.1	0.25	0
T9	Neem + Korhtuma	4.75	1.1	0.15	0.25	0.05
T10	Dhatura + Tobacco	7.45	1.6	0.15	1.05	0.85
T11	Dhatura + Ak	1.4	0.4	0.25	3.35	3.15
T12	Dhatura + Korhtuma	2.1	0	0.4	0.3	0.05
T13	Tobacco + Ak	1.25	0.6	0.15	0.2	0
T14	Tobacco + Korhtuma	2.7	4.3	0.35	0.25	0.1
T15	Ak + Korhtuma	2.9	0.15	1.05	0.65	0.45

8.3 Comparative effectiveness of different modules for the management of mango fruit borer

The experiment was planned to establish a work plan to manage mango fruit borer through timely cutting of malformed panicles and insecticidal application. The experiment consisted of treatments viz., Module 1=Traditional cutting of malformation (in two spells), Module 2= Traditional cutting of malformation (in two spell) + One Spray of Coragen @ 40 ml/100L, module 3= Traditional cutting of malformation (in two spell)+Two Sprays of Coragen @ 40 ml/100L, module 4=Extensive cutting of malformation (in three spells) + No spray, module 5= Extensive cutting of malformation (in three spells) + One Spray of Coragen @ 40 ml/100L, module 6= Extensive cutting of malformation (in three spells) + Two Spray of Coragen @ 40 ml/100L. The experiment

was conducted on variety Sindhri. The area under each module was one acre, out of which 3 trees were marked for recording observations. Traditional cutting of malformation (in two spell) was done at end of March and after fruit setting. Extensive cutting of malformation (in three spells) was started at end of March and 2nd and 3rd spell will be done with the intervals of 15 days. The damage/ infestation of the fruit borer was recorded by observing one cluster from each cardinal direction of each experimental plant. The insecticidal spray was done on the appearance of damage symptoms i.e. black spots on fruits in clusters or recording alive larvae, while second spray (if required) was done 15 days after first spray. Data was recorded with the intervals of one week by observing one fruit cluster in each cardinal direction of each experimental trees. Damage clusters of fruits were tagged & not counted during further data record. Data recording was continued till fruit harvest & data was statistically analyzed.

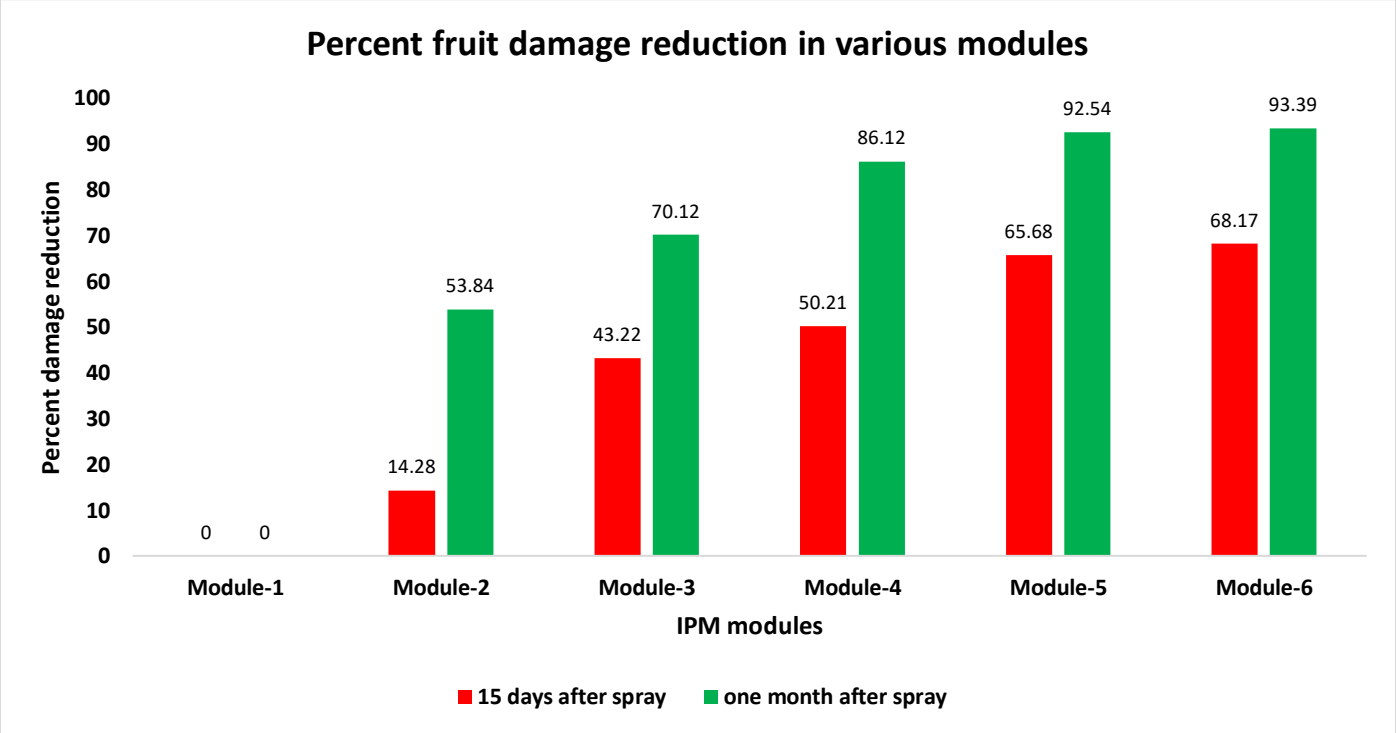


Fig 11: Percent fruit damage reduction in various modules 15 days and one month after spray.

Maximum damage reduction (93.39%) of fruit borer was observed in module VI where two sprays of coragen was done along with the extensive cutting of malformation in 03 spells followed by module V.

8.4 Evaluation of different colors for attraction of fruit fly in sex pheromone traps

This experiment was conducted to find out the best color for making sex pheromone trap attractive for male fruit fly. Sex pheromone traps of five different colors i.e. white, black, yellow, red, blue and green were installed at 05 different locations of mango zone of South Punjab. One trap of each color was hanged on the

same tree under shade at the height of 5 feet and all these six traps were considered as a replication. The cotton plugs of appropriate size soaked in mixture of methyl eugenol (09 parts) and malathion (01 part) was used as a standard attractant to capture and kill the male fruit flies for the period of one week. The captured flies were counted on weekly basis. The data revealed that 35.44% of the total population of fruit fly was trapped in yellow colored traps followed by white colored traps (25.51%). The minimum population (4.67%) was observed in case of black colored traps. (Fig. 8.3)

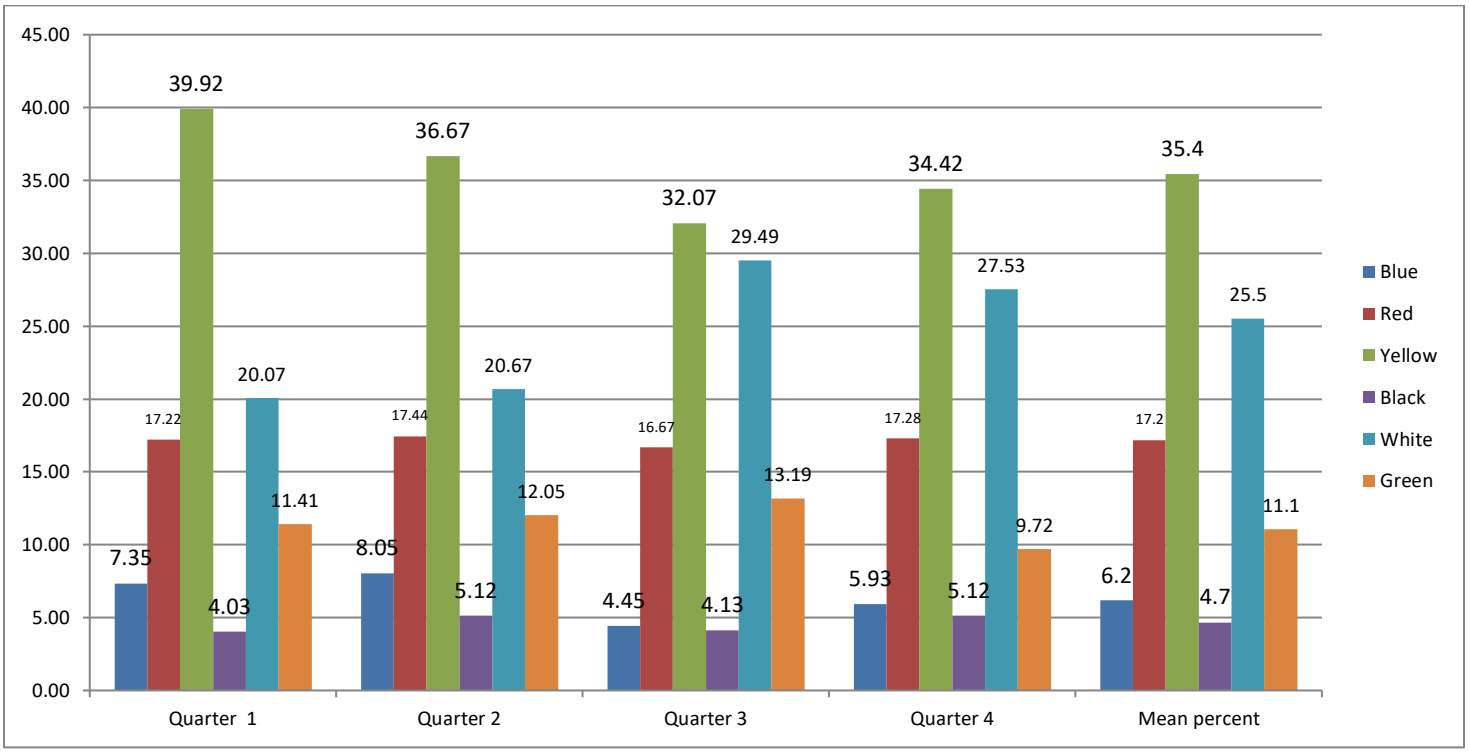


Fig. 12: Comparative attractiveness of various colors in different traps.

8.5 **Determination of most effective dosage of two different insecticides against Mango Fruit borer**

The experiment was conducted to determine the effective dosage of two insecticides i.e Coragen 20SC (Chlorantraniliprol) and Belt 480 SC (Flubendiamide) already proven their effectiveness against mango fruit borer. The experiment consisted of treatments viz 4 doses of insecticide coragen and 4 different of insecticide belt. The insecticidal application was done on the appearance of damage symptoms i.e. black spots on fruits or appearance of pest as protective spray. Data was recorded with the intervals of one week by observing ten fruit cluster of each experimental trees. Data recording was continued till fruit harvest and statistically analyzed.

Table 17: Percent infestation of mango fruit borer in different doses of insecticide sprayed.

Insecticide	**Percent infestation**			
	Before spray	**One week after spray**	**Two weeks after spray**	**Three weeks after spray**
Coragen @ 10ml / 100L water	15.62	13.69	6.34	1.58
Coragen @ 20ml / 100L water	67.14	12.5	11.66	0
Coragen @ 30ml / 100L water	22.05	16.07	3.12	0
Coragen @ 40ml / 100L water	64.28	2.08	1.51	0
Belt @ 10ml / 100L water	32.91	13.55	5.08	3.33
Belt @ 15ml / 100L water	37.17	10.0	3.33	1.51
Belt @ 20ml / 100L water	55.26	10.93	3.12	1.66
Belt @ 25ml / 100L water	45.12	8.69	1.51	0
Control	24.63	31.88	36.78	16.1

9. Post-Harvest Section

9.1 Exploring the best time for fruit bagging of commercial mango cultivars

This experiment was initiated with the objective to evaluate the best time for fruit bagging to produce quality mangoes. The following treatments were tested on mango Cv. Sufaid Chaunsa to achieve the said target.

Table 9.1: Various treatments for exploring the best bagging time of commercial mango cultivars.

Treatment	Description
T_1	fruit bagging 60 days before harvesting
T_2	fruit bagging 50 days before harvesting
T_3	fruit bagging 40 days before harvesting
T_4	fruit bagging 30 days before harvesting
T_o	Control

500 fruits were wrapped on 03 trees of mango cv. Sufaid Chaunsa under each treatment. The bagging was started 60 days before harvest and carried on with the interval of 10 days (50 days, 40 days and 30 days before harvest). Fruits of the control plants were also tagged. The dropped bags were counted at regular interval (twice a week). The fruits samples were harvested and analyzed the bagged and un-bagged fruits on the basis of their weight, physical appearance, incidence of insect pest damage/heat injury and shelf life.

Table 18: Characteristics of fruits in different treatments.

#	Treatment Description	Weight (g)	Fruit drop	Physical appearance	Physical appearance on ripening	Heat injury	Fruit fly affected	TSS On harvest	TSS On ripening	Shelf life (days)
T_1	Fruit bagging 60 days before harvesting	535	4%	Yellowish	Uniform Yellowish	0	0	13.3	22.3	8
T_2	Fruit bagging 50 days before harvesting	530	3%	Yellowish	Uniform Yellowish	0	0	12.9	22.2	8
T_3	Fruit bagging 40 days before harvesting	539	2%	Yellowish	Uniform Yellowish	0	0	12.3	22.0	8
T_4	Fruit bagging 30 days before harvesting	528	1%	Light Yellowish	Uniform Yellowish	0	2%	12.1	21.9	8

T_o	Control	536	6%	Green	Light Yellowish with scratches	5%	13%	12.0	21.5	8

The data revealed that the fruits bagged before 60,50 and 40days of harvest reflected uniform yellowish color development while the treatment of 30 days showed light yellowish including greenish color at unripe stage. The TSS of 60 & 50 days bagged fruits were slightly higher as compared to 40 & 30 days. On ripening, the color development, TSS and shelf life in all treatments remained at par.

9.2 Evaluation of different harvesting methods to sustain fruit quality

This experiment was initiated with the objective to find out the best harvesting methods to sustain fruit quality. The following treatments were tested to achieve the said target.

Table 17: Various treatments used in evaluation of different harvesting methods to sustain fruit quality.

Treatment	**Description**
T1	Direct fruit drop with conventional picking tool
T2	Fruit drop at foam
T3	Fruit catch with bag
T4	Fruit lowering with Cheeko
T5	Hand picking

200 mature fruits of cultivar Chaunsa SB were harvested under each treatment. The picked fruit were packed for ripening at ambient temperature. Data were recorded regarding physical damage at harvest (External) and fruit damage on ripening (Internal).

Table 19: Physical damage at harvest and ripening in different treatments.

#	Treatment	Physical damage at harvest	Physical damage at ripening	Overall damage
T_1	Fruit picking with conventional tool & drop	2%	8%	10%
T_2	Fruit drop at foam	0.5%	2%	2.5%
T_3	Fruit catch with bag	0%	0%	0%
T_4	Fruit lowering with Cheeko	0%	0%	0%
T_o	Hand picking	0%	0%	0%

It was found that the fruits harvested under T_3, T_4 & T_5 were sustainable to maintain the quality of the fruit as compared to the fruits harvested under T_1 & T_2.

9.3 The Screening of suitable varieties for dry mango production

This experiment was initiated with the objective to find out suitable variety for dry mango. The following treatments were tested to achieve the said target.

The following treatments were used in experiment.

Treatment	Description
T_1	Langra
T_2	Sindhri
T_3	Anwar Retual
T_4	Chaunsa SB
T_5	Chenab Gold
T_6	Sufaid Chaunsa
T_7	Sensation
T_8	Azeem Chaunsa

100kg fruits of each mentioned variety were harvested at maturity. The slices of fruit at recommended ripening stage (70% ripening) were prepared by adopting developed protocols. The slices were dried at 60-65ºC for 18 hours in fruit dryer. After removing the heat, the prepared slices were packed in polyethene bags in 100g packing. 30 packets of each variety with proper tagging were placed to record the data of color, texture, flavor and shelf life on monthly basis. The following data recorded at the time of packing of slices is given below:

Table 20: Effect of drying on texture & flavor of mango slices of different cultivars

#	**Treatment**	**Color appeared**	**Texture**	**Flavor**
T_1	Langra	Light brown	Weak	Sweet
T_2	Sindhri	Yellowish	Strong	Light sour
T_3	Anwar Retual	Light brown	Weak	Sweet
T_4	Chaunsa SB	Light brown	Weak	Sweet
T_5	Chenab Gold	Light yellowish	Weak	Light sour
T_6	Sufaid Chaunsa	Creamy White	Strong	Sweet
T_7	Sensation	Yellowish	Strong	Sweet
T_8	Azeem Chaunsa	Yellowish	Strong	Sweet

It was found that the texture of slices under T_2, T_6, T_7 & T_8 was strong. The natural flavor/taste of T_6, T_7 & T_8 were sweet while T_2 have sour flavor. The monthly data recording regarding shelf color texture and flavor and storage life is in progress.

ANNUAL TECHNICAL REPORT
For the Year of

2021-22

Submitted by:
Principal Scientist-Horticulture
Mango Research Station
Basti Malook Road, Tehsil Shujabad
District Multan
Contact No. +92 345 6541064
E-mail: **mrsshujabad@gmail.com**

INDEX

ANNUAL TECHNICAL REPORT FOR THE YEAR 2021-2022
MANGO RESEARCH STATION, TEHSIL SHUJABAD, 6KM BASTI MALOOK ROAD DISTRICT MULTAN

E-mail: mrsshujabad@gmail.com

Javed Iqbal
Principal Scientist-Horticulture
Mango Research Station Shujabad

INTRODUCTION

Mango (*Mangifera indica* L.) is a perishable fruit of Pakistan and attained a prominent position in terms of cultivation on an area (214.42 thousand hectares) which generate annual production (2444.65 thousand tonnes) out of which 129.6 thousand tonnes quantity enter into international trade of worth 11.9 million U$ (FAO, 2020-21). Currently this station is working on development of new mango varieties with the help of crosses of diverse nature of mango germplasm having superior traits. Existing mango germplasm maintenance, conservation and explore its characterization is part of research activities. Registration of two new mango cultivars from Punjab Seed Council, Lahore viz. Chenab Gold and Azeem Chaunsa under the aegis of Mango Research Institute, Multan are in progress. Research endeavor were rendered for the development of canopy based healthy, clean mango nursery potted plants and capacity building program for the mango nurserymen of 11 districts of South Punjab has been successfully conducted.

TECHNICAL STAFF POSITION

Designation	**No. of posts**	**In position**	**Vacant**
Principal Scientist	1	-	1
Senior Scientists	3	3	-
Scientific officers	2	2	-
TOTAL	**6**	**5**	**1**

WEATHER& ITS EFFECTS:

Month	Average Temperature °C		Temperature Extremes °C		Rainfall dates	W. Storm/Frost Dates	Average Relative Humidity %	
	Day	Night	Max.	Min.			Morning	Evening
July,21	38.8	30.9	42.0	28.0	12,28	w.s = 4	87	57.1
Aug,21	36.8	29.1	39.0	23.0	2, 4	--	75.5	53.9
Sep, 21	35.7	27.8	38.0	25.0	21	--	77.8	52.8
Oct, 21	33.8	20.4	37.0	28.0	-	--	78.2	57.7
Nov,21	28.1	13.2	31.0	28.0	-	--	78.4	48.1
Dec, 21	21.7	7.1	26.0	19.0	---	--	79.2	48.6
Jan, 22	19.7	8.2	22.0	18.0	--	F=1,2,3,4,5,6,18	92.1	67.4
Feb, 22	23.2	9.6	25.0	5.0	--	F=7	94.3	69.2
Mar,22	24.5	18.2	30.0	10.0	3,10,17	--	86.3	62.1
Apr,22	33.9	20.2	43.0	17.0	3,6,,24	--	67.0	43.5
May,22	37.8	29.6	43.0	18.0	--	--	64.0	43.7
Jun, 22	44.01	33.5	47.0	26.0	---	--	62.1	42.4

Hot and humid weather was observed during the months of July, August and September 2021. This weather favored the attack of Fruit Fly on Mango fruits/plants. It also put favorable effects on Nursery Plants. During Dec, Jan,Feb and March which stunt the plant growth and enhanced the Powdery Mildew and Blossom Blight disease in Mango. Then in April, May and June dust storm caused heavy fruit drop in Mango crop.

EXPERIMENT. 1 DEVELOPMENT OF NEW MANGO VARIETIES BY BREEDING PROGRAM

The experiment was designed to develop new mango varieties with superior traits. The crossing work was planned as reciprocal approach consisted of five local commercial mango varieties and five superior exotic mango varieties as in Fig.1(A& B). The crossed fruit were kept under care regularly and adequate plant protection strategy was used in order to protect from various insect and disease invasion. The detail of hybrid mango plants under this program were as listed below (Table.1).

Table 1. Mango hybridization program and hybrid plants achieved during 2021-22

Sr #	Combination	Objective	Total crosses	Fruits harvested
1	Sindhri x Keitt	To evolve mango variety with better uniform fruit size	3000	27
2	Keitt x Sindhri		3000	27

3	Chaunsa SB x Momi K	To development mid-season variety with better shelf life	3000	31
4	Momi K x Chaunsa SB		3000	08
5	SufaidChaunsa x Haden	To evolve mango variety with better quality traits	3000	09
6	Haden x SufaidChaunsa		3000	08
7	Chenab Gold x Sensation	To development mango variety with superior traits	3000	32
8	Sensation x Chenab Gold		3000	01
9	AzeemChaunsa x R2E2	To develop large size mid-season variety	3000	04
10	R2E2 x AzeemChaunsa		3000	02

Fig.1(A.&B). Mango stamen collection for preparation of pollen suspension culture

EXPERIMENT 2. EFFECT OF APPLICATION OF VARIOUS NUTRITIONAL LEVELS AT DIFFERENT TIMES ON HEALTH AND VIGOR OF MANGO POTTED NURSERY PLANTS

Research was conducted to evaluate the optimum dose of nutrition and evaluate its time of application to the mango nursery plants. The NPK (20:20:20) was used @ control or no application, 5, 10 and 15g to potted mango nursery plants. The time of application of fertilizer dose was three as before transplanting of mango seedling plants into polybag, two weeks after transplanting of seedlings and similarly after four weeks of transplanting of seedlings into polythene bags under nursery tunnel. The results were of different parameters were recorded to evaluate the optimum dose and time of fertilizer application to the potted nursery plants as shown in (Table.2).

Table 2. Data of different parameters of mango plants growth and success percentage

Treatments	N.P,K (g)	Time of Application	Plant height (cm)	No. of leaves /plant	Success % of grafted plants	Plant height (cm)
T_1	05	Before transplanting	22	7	77	65
T_2	10	-do-	24	9	69	62
T_3	15	-do-	25	8	71	63
T_4	05	02 weeks after transplanting	29	8	77	72
T_5	10	-do-	27	10	81	73
T_6	15	-do-	29	7	76	73
T_7	05	04 weeks after transplanting	32	13	82	80
T_8	10	-do-	33	10	79	77
T_9	15	-do-	32	11	68	75
T_{10}	0	Control	18	8	43	72

The data indicated that NPK (20:20:20) application prior to transplanting cause maximum mortality of the plants. However, plant growth wasfound better in T_7, T_8& T_9. Maximum Number of leaves per plant was counted (13) and success (82%) was obtained in T_7 with maximum plant height 80 cm.

EXPERIMENT 3. STANDARDIZATION OF HOT WATER DIP DURATION TO CHECK INFESTATION OF FRUIT FLY IN MANGO FRUIT

This research experiment was conducted to optimize the dip duration of hot water to mango fruits for eradication of fruit fly infestation to commercial mango cultivars i.e. Sindhri, Chaunsa SB and SufaidChaunsa. Mango fruits were harvested when attained its proper maturity and placed under fruit fly cage for oviposition for a period of 72 hours for egg laying in the fruits. Then the fruits were applied hot water treatment and temperature was set 48°C and fruit were immersed in this hot water tank for a period of 10, 20, 30, 40, 50 minutes and undipped or control. The mango fruits were allowed to ripen and then analysis for the fruit fly maggots were conducted in order to inspect the presence of fruit fly larvae.

Table 3. Fruit fly infected mango fruits after ripening in different dip duration of hot water treatment

Variety	T_1	T_2	T_3	T_4	T_5	T_6
Sindhri	100% contamination	1	0	0	0	0

Chaunsa SB	100% contamination	0	0	0	0	0
SufaidChaunsa	100% contamination	2	1	0	0	0

The results recorded reflected that fruit fly infestation in fruits for all varieties after ripening has been observed in 100 % fruit under control while under the remaining treatments for all varieties remained free from infestation of fruit fly except T_2 where contaminated fruits were recorded (Table.3) Therefore, it can be concluded that the hot water dip duration of 20 minutes is equally safe to eliminate the fruit fly as compared to 60 minutes of hot water dip durations.

EXPERIMENT 4. SURVEY FOR SELECTION OF PROMISING MANGO STRAINS

Intensive survey of Punjab was made to identify the promising mango strains for evaluation and induction selection program for the mango industry of Pakistan. In the first phase, the attractive varieties was evaluated at the existing sites and if found attractive (in phase-II) then these varieties were multiplied and studied at Mango Research Station, Shujabad. The following characteristics were recorded to capture the suitable variety.

Previously selected two promising strains i.e. Late Sindhri and AzeemChaunsa were evaluated and tested over the last ten years and now under the registration process. In last year, a new mango strain SS-09 (Fig.2) was selected for further study. In recent year, a variety from Kabirwala named as SS-10 (Fig.3) was selected for further study after initial fruit testing.

Fruit Characteristics of both varieties are as under.

SS-09

Fruit weight:	350 -420 g
TSS:	19-21%
Stone weight:	Small (60-75 g)
Flesh:	Firm and fiber free
Skin colour	Yellow with red blush
Fruit color	Deep yellow
Flesh color:	Deep yellow
Fiber	Scanty
Maturity time:	Mid July
Av. Plant Yield:	Good to High
Shelf life	Prolonged-Excellent-best

Fig.2:SS-09

SS-10

Fruit weight:	380 g
TSS:	17-18%
Stone:	Medium in size (30-40 g)
Flesh:	Firm/Compact/Fiber free
Skin and flesh color	Deep yellow
Maturity time:	Mid July
Av. Plant Yield:	High
Shelf life	Extended

Fig.3:SS-10

ACHIEVEMENTS :

RESEARCH PUBLICATIONS

1. Kiran, S., J. Iqbal, S. Danish, A. Bakhsh, S.I.U.S. Bukhari, F. Bibi, K.D. Alotaibi, S. Fahad, O. Nasif, A.T.K. Zuan and R. Datta. 2021. Physio-chemical characterization of indigenous agricultural waste materials for the development of potting media. *Saudi J. Biol. Sci.* 28:7491–7498.
2. Iqbal, J., S. Kiran, S. Hussain, R.K. Iqbal, U. Ghafoor, U. Younis, T. Zarei, M. Naz, S.G. Germi, S. Danish, M.J. Ansari and R. Datta. 2021. Acidified biochar confers improvement in quality and yield attributes of sufaid chaunsa mango in saline soil. *Horticulturae* 7:1–18.

OTHER DEVELOPMENT ACTIVITIES

- Capacity Building Program 19
- Seminar 02
- Webinars 02
- Farmer Gathering 09
- Class Visited 02
- Internee B.Sc. (Hons) Agri. 04
- Growers Visited 120
- Orchard Visited 70
- Clean Mango Nursery plants sold 15348
- Mango Exhibitions 04

Other Activities

1. Visited more than one hundred and seventy orchards and problems of orchards were assessed and growers were advised at the spot accordingly.
2. Advice is also rendered to the farmers visiting the institute and it's out Stations.

LIST OF RESEARCH STAFF

Sr. No.	Name	Post Held	Qualification
1.	Javed Iqbal	Senior Scientist	M.Sc. (Hons) Agri. Horticulture
2.	Faheem Khadija	Senior Scientist	M.Sc. (Hons) Agri. Horticulture
3.	Sidra Kiran	Senior Scientist	M.Sc. (Hons) Agri. Horticulture
4.	Riaz Hussain	Scientific Officer	M.Sc. (Hons) Agri. Horticulture
5.	Muhammad Iqbal	Scientific Officer	M.Sc. (Hons) Agri. Horticulture

JAVED IQBAL
Principal Scientist-Horticulture
Mango Research Station
Shujabad

Research Publications:

1. Ahmad, Z.; Naeem, M.; Azad, R.; Hussain, I.; Bibi, R.; Zaman, M.; Akbar, R.; Zafeer, N.; Elgezouly, R.O.E.; Mustafa, G. Multivariate diversity analysis and systematics of hemipteran insects of family Reduviidae. *Journal of King Saud University-Science* **2022**, *34*, 101722.
2. Usman, M.; Ayoub, A.; Mustafa, G.; Rasheed, K.; Nadeem, M.K.; Ashfaq, H.; Shahid, M.U.; Parveen, M. Nanotechnology: A New Technology in Insect and Disease Control. *Annals of the Romanian Society for Cell Biology* **2022**, *26*, 1605-1615.
3. Hameed, A.; Karar, H.; Ghaffar, A.; Khan, A.H.; Mubashir, M.; Mustafa, G. Role of Insect Pollinators in Fruit Setting, Economic Value of Pollination, and Pollinator Fauna on Different Commercial Mango Varieties in South Punjab Pakistan. **2022**.
4. Kiran, S.; Iqbal, J.; Iqbal, A.; Bukhari, S.I.U.S.; Iqbal, M.; Mustafa, G.; Khan, A.H.; Hussain, R.; Khan, A.; Majeed, T. Development of sustainable mango pot media nutrition for healthy and clean mango nursery plants.
6. Iqbal, J.; Kiran, S.; Mustafa, G.; Khan, A.; Raza, A.; Bibi, F.; Hussain, R.; Bukhari, S.; Iqbal, N.; Khan, A. Effect of different nursery potting media on the germination and development of mango (*Mangifera indica* L.) seedlings. *Biological and Clinical Sciences Research Journal* **2022**, *2022*.
7. Akram, R.; Amanet, K.; Iqbal, J.; Fatima, M.; Mubeen, M.; Hussain, S.; Ali, M.; Nasim, W.; Ahmad, A.; Farid, H.U. Climate Change, Insects and Global Food Production. In *Climate Change and Ecosystems*, CRC Press: pp. 47-60.
8. Hameed, A.; Rosa, C.; Rajotte, E.G. A Review on Ecology of Interactions in Soybean Vein Necrosis Orthotospovirus (SVNV): Plants, Vectors, Virus Dispersal and Management Perspectives. **2022**.
9. Hameed, A.; Rosa, C.; Rajotte, E.G. The Effect of Species Soybean Vein Necrosis Orthotospovirus (SVNV) on Life Table Parameters of Its Vector, Soybean Thrips (Neohydatothrips variabilis Thysanoptera: Thripidae). *Insects* **2022**, *13*, 632.
10. Hameed, A.; Ulmer, J.M.; Miko, I.; Rosa, C.; Rajotte, E.G. Morphology of the Female Reproductive System of the Soybean Thrips, Neohydatothrips variabilis (Beach, 1896)(Thysanoptera: Thripidae). *Insects* **2022**, *13*, 566.
11. Babar, M.H.; Sarwar, G.; Khan, A.; Hameed, A.; Mahmood, K.; Tauseef, M.; Anwar, S.A.; Muhammad, T.; Javed, M.H.; Akhtar, B. Bio-efficacy of PB-rope (l) as mating disruptant against pink bollworm, *Pectinophora gossypiella* (Saunders) in cotton. *Plant cell biotechnology and molecular biology* **2022**, 33-42.
12. Naqvi SA, Wang J, Malik MT, Umar UU, Hasnain A, Sohail MA, Shakeel MT, Nauman M, Hassan MZ, Fatima M, Datta R. Citrus Canker—Distribution, Taxonomy, Epidemiology, Disease Cycle, Pathogen Biology, Detection, and Management: A Critical Review and Future Research Agenda. Agronomy. 2022 Apr 29;12(5):1075.

Books Published

- Brochure on Small Tree System (STS) in mango was developed.

Calendar Guides for farmers:

- Calendar Guide for mango orchards was published.

Popular Articles

1. Management of Mango Mealy Bug. Zarat nama January 01, 2022. By **Abid Hameed Khan**, Abdul Ghaffar Grewal, Dr. Asif Hameed and Muhammad Imran
2. Mango malformation and its management. Zarat nama February 01, 2022. By Muhammad Tariq Malik, Abdul Ghaffar Grewal, Muhammad Imran and **Abid Hameed Khan**
3. Mango Diseases during flowering season. Zarat nama March 01, 2022. By **Abid Hameed Khan,** Abdul Ghaffar Grewal, Muhammad Tariq Malik, Dr. Asifa Hameed, Muhammad Imran and Atif Iqbal
4. Mango Insect Pests and their Management. Zarat nama April 01, 2022. By **Abid Hameed Khan,** Abdul Ghaffar Grewal, Muhammad Tariq Malik, Dr. Asifa Hameed, Muhammad Imran and Atif Iqbal
5. Mango orchard management after fruit setting. Zarat nama April 15, 2022. By Abdul Ghaffar Grewal, **Abid Hameed Khan,** Muhammad Tariq Malik, Dr. Asifa Hameed, Muhammad Imran and Atif Iqbal
6. Fruit Fly – a new threat for mango orchards. Zarat nama June 01, 2022. By Abdul Ghaffar Grewal, **Abid Hameed Khan,** Dr. Asifa Hameed, Muhammad Tariq Malik and Atif Iqbal

Radio/TV talks/Webinars:

Webinars:

1) Mango diseases and their control in webinar organized by MNS University of Agriculture, Multan and MRI Multan on September 27, 2021.
2) "Mango orchard management to produce clean and healthy fruits next year" on November 3, 2021 organized by Trade Development Authority, invited speakers were scientists of MRI.
3) 'Mango insect pests and their management during dormancy" in a webinar entitled, "Mango orchard management during dormancy phase on December 13, 2021 organized by TDAP invited speakers were scientists of MRI.
4) "Mango orchard management during flowering for better fruiting" on Feb 24, 2022.
5) "Mango Insect pest management" on Feb 24, 2022 invited speakers were scientists of MRI.
6) "Mango insect pests and disease management during flowering season in webinar entitled, "Mango production and orchard management" organized by sustainable Agriculture water and intelligent system (SAWIE) international Pakistan on Feb 26, 2022. Invited speakers were scientists of MRI.

Training of farmers:

1. Abid Hameed Khan (Scientific officer, Plant Pathology) delivered a lecture on "one-day capacity building program of mango growers at JalalPur organized by Department of soil science BZU Multan dated 02.07.2021.
2. Abid Hameed Khan (Scientific officer, Plant Pathology) delivered a lecture to Gourmani District farmers on 03.07.2021 organized by Soil Science Department of BZU.
3. Malik Tariq delivered a lecture on the "Mango diseases symptoms, epidemiology and management dated 16.02.2022.
4. Malik Tariq delivered a lecture to the Syngenta (Pvt) field officers and marketing staff about mango diseases and their management.
5. Malik Tariq delivered a lecture on Integrated disease management IDM to mango growers at Vehari dated 21.02.2022.
6. Abid Hameed Khan (Scientific officer, Plant Pathology) delivered a lecture on the Integrated pest management, pest symptoms and epidemiology in Training program of Agriculture officers at RAEDC Vehari on 21.02.2022.
7. Abid Hameed Khan (Scientific officer, Plant Pathology) delivered a lecture on Integrated Pest Management and Pest Symptoms and epidemiology on 21.02.2022
8. Abid Hameed Khan (Scientific officer, Plant Pathology) delivered a lecture on the mango insect pests and disease management during flowering season in Mango Seminar organized by FFC Multan at FFC warehouse southern bypass Multan March, 1, 2022.
9. Mango orchard management by Abdul Ghaffar Grewal (Principal Scientist, Horticulture), Malik Tariq Senior Scientist (Plant Pathology) and Abid Hameed Khan (Scientific officer, Entomology) dated 01.03.2022.
10. Malik Tariq delivered a lecture on "Integrated disease management" in Vehari to mango growers and nursery managers dated 13.04.2022.
11. Abid Hameed Khan (Scientific officer, Plant Pathology) delivered a lecture on the "Effect of climate change on Mango production, present challenges and future strategies organized by MNS University of Agriculture, Multan on May 18, 2022.
12. Abid Hameed Khan (Scientific officer, Plant Pathology) delivered a lecture on the mango insect pests to BSc (Hons.) Agri-Entomology Students from University of Agriculture FSD on May 31,2022.
13. Abdul Ghaffar Grewal and Madam Fatima Bibi delivered 2 farmer days on 12.06.2022 and 27.06.2022. (Attendance sheet attached).
14. Four nursery trainings were given to growers in 4 farmer days from January to March.

Training of scientists

1) Dr. Javed Iqbal Principal Scientist (Horticulture) received a training on “Think patent, the value of patent documentation for innovation and research” on July 1, 2021.
2) Dr. Javed Iqbal Principal Scientist (Horticulture) received a training on “How drone mapping is used for the trial management and statistical analysis” on July 15,2021.
3) Dr. Asifa Hameed, Senior Scientist (Entomology) Mango Research Institute, received a training on “Finance, administration, management and E-Governance" From September 13 to October 8, 2021.
4) Dr. Mubashir Qureshi, Senior Scientist (Soil Science), Mango Research Institute, Multan received a training on “Finance, administration, management and E-Governance" From September 13 to October 8, 2021.
5) Mr. Ghulam Mustafa, Senior Scientist (Horticulture), Mango Research Institute, Multan received a training on “Finance, administration, management and E-Governance" From September 13 to October 8, 2021.
6) Dr. Javed Iqbal Saqi, Senior Scientist (Horticulture), Mango Research Station Shujabad received a training on “Finance, administration, management and E-Governance" From 26.10.2021 to 20.11.2021”
7) Mr. Abdul Ghaffar Grewal Principal Scientist (Horticulture), Mango Research Institute, Multan obtained a training on “Finance, administration, management and E-Governance" From 16.05.2022 to 10.06.2022”
8) Ms. Fatima Bibi, Scientific officer (Soil Science) received a training on “Handling of spectrophotometer conducted by Mr. Hamza bin Rashid Engineer on 22nd June 2022.
9) Dr. Mubashir Qureshi Senior Scientist (Soil Science) received a training on “Handling of spectrophotometer conducted by Mr. Hamza bin Rashid Engineer on 22nd June 2022.

Projects:

1. ADP PROJECT - Promotion of fruits production in Punjab through the provision of certified plants.
2. PARB-20-241 "Development of new mango varieties with superior traits and management strategies against vivipary and under skin browning in mango cv. Sufaid Chaunsa".
3. PARB PROJECT - 904 Nutrition enhancement of crops, fruits, vegetables and their products on climate change scenario.
4. PARB PROJECT - 20-36 Import of high value germ plasm and technologies of elite exotic fruits, vegetables, and additional crops for diversification and sustainable production in Punjab.