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ANNUAL TECHNICAL REPORT, 2019-20

MANGO RESEARCH INSTITUTE, OLD SHUJABAD, AGRICULTURE COMPLEX, MULTAN

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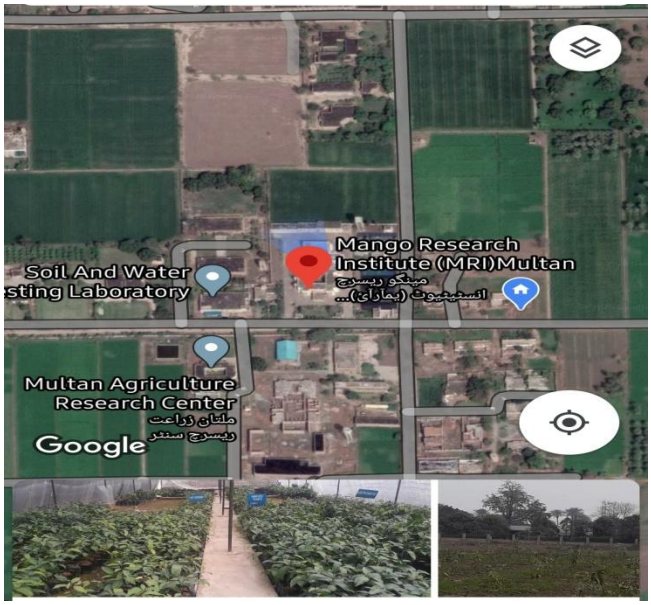
1. OVERVIEW:

Mango (*Mangiferaindica* L.) is a prominent exportable fruit of Pakistan which thrives best in summer season and manifests its golden look that decorates the main shelf of shops, vendors and even in the market. Pakistan stands at 6th position in the global mango production and arrested the area under its cultivation 170.74 thousand hectares that produce 1758 thousand tons while Punjab province has 98.49 thousand hectares with annual production of 1330.16 thousand tones share during 2018-19. The Mango Research Institute, Multan along with its paraphernalia Mango Research Station, Shujabad are the premium and dedicated research organization that are working on uplifting mango sector in the country since long. The research team is also engaged to evaluate the feasibility of mango dense plantations both at public and private sector. In the near future work on establishment of a full fledge station at RY Khan for the better dissemination of technologies of mango growers, also at the priority. This institute has launched SMS castor services, social media campaign, news and brochures and training for the phenology based

Seminar/workshop for the awareness of mango growers in various districts of mango regions. Containerize mango nursery is also flourishing and provision of certified mango nursery plants on subsidized rates to the mango growers is also part of services delivery. These mango varieties also have the potential to combat various climate harnesses at various value chain components. This research institute has facility of horticulture, entomology, pathology, nutrition and postharvest sections to gear up the work on problems being faced by all the stake holders. In addition to these services, enrichment of new mango varieties for the extended window of supply chain also strengthens the mango fruit industry.

2. GEOGRAPHICAL LOCATION

Mango Research Institute, is situated at old Shujbad Road, Rangilpur, Multan, Punjab



3. AREA AND PRODUCTION OF MANGO IN PUNJAB

Sr,No	Name of Institute/Farm	Total Current area	Cultivated area	Area under road and building
1	2	3	4	5
1	Mango Research Institute, Multan	32.10 Acres	24 Acres	8-10 Acres
2	Mango Research Station, Shujabad	79 Acres	60 Acres	19 Acres

3	Mango Germplasm Unit, Khanewal	25 Acres	23 Acres	02 Acres

4. OBJECTIVES

- ✓ **Horticulture Section**
  - To develop varieties through Hybridization, Selection and Introduction
  - To evaluate newly developed four mango varieties at MRS-Shujabad with respect to better yield, quality and resistance against abiotic stresses, diseases and insects
  - To plant, maintain and evaluate mango germplasm with respect to national as well as international markets
  - To explore polyembryonic root stock for mango propagation
  - To raise true to type mango nursery plants on known root stock in soil less media
  - To establish high density orchard using dwarf root stock with optimum canopy management
  - To standardize techniques of pruning and application of growth retardants for the restoration of unproductive orchards
  - To transfer the standardized technology to the farmers
  - To study the national as well as international market requirements and their standards for the boost in export of mango from Punjab
- ✓ **Pathology Section**
  - To conduct experiments for the efficient control of different diseases especially blossom blight, powdery mildew, panicle malformation, anthracnose, bacterial blight and sudden death phenomenon in mango
- ✓ **Entomology Section**
  - To conduct experiments for the control of different insects especially hopper, midge, fruit fly, thrips, stem borer and leaf minor
- ✓ **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 conduct experiments on the plant nutrition and soil management for the sustainable production of quality mangoes

5. HORTICULTURE SECTION

5.1. Use of interstock technique in mango to evaluate its impact on plant dwarfness and fruit maturity in mango cv. Sindhri

This research trial was performed with objective to invigorate the dwarfness character in local vigorous growing mango cultivar Sindhri. The polyembryonicmango variety 13-1 originated in Israel was used as rootstock and it possess good tolerance toward the calcareous based soil. Theexperiment consisted of four treatment T_1 (13-1 rootstock interstocked with Sensation and final stock with Sindhri), T_2 (13-1 rootstock interstocked with Neelum and final stock with Sindhri), T_3 (13-1 rootstock interstocked with TotaPari and final stock with Sindhri) and T_4 (13-1 rootstock interstocked and final stock with Sindhri) repeated four times under RCBD design. Our local acclimatized dwarf mango cultivars like Sensation, Neelum, TotaPari and vigorous growing cultivars Sindhri were used as interstock. When these interstocks attained the graftable height and girths, the scion of Sindhri was final grafted on these interstocks accordingly. These plants were transferred to bigger pots for further growth in October, 2016. These plants will be transplanted in the field condition for required studies in October, 2019. The results showed that maximum plant height (130cm) and number of flushes per plants (07) were recorded in T_4 whereas minimum plant height (60cm) and number of flushes per plants (03) were recorded in T_3 (Neelum). The dwarfness character was manifested well in case of Neelum and second most was (90cm) inTotaPariinterstock plants as shown in (Fig.1 and 2)

Fig. 1 Manifestation of various polyembryonic rootstocks (A) and various indigenous mango cultivars used as interstock (B) and final stock with Sindhri(C) in order to invigorate the dwarfness traits via grafting

Fig.2 Left to right) TotaPari(A) as interstock,sindhri (B) as interstock, sensation (C)as interstock, Neelum (D)as interstock

5.2. Development of new mango varieties through hybridization

This research experiment was initiated to develop new mango varieties with better yield and quality traits through hybridization of promising mango cultivars. The varieties were selected due to salient features as Sindhri possess early season maturity, good shelf life but tapka when fruit is mature; SufaidChaunsa have good on tree storage, no tapka, good shelf life, but late season maturity. Sensation is red colored blush cultivar, dwarf in nature, late maturing and firm texture of pulp in fruits; SB Chaunsa have good characters of sweetness, mid-season maturity, but difficult in regular cropping behavior. The reciprocal cross strategy was adopted due to transfer of cytoplasm traits into next progeny. It comprised of three crosses T_1 (SufaidChaunsa x Sindhri), T_2 (Sindhri x SBChaunsa), T_3(SB Chaunsa x Sensation) and reciprocated as well. These mango cultivars emerged late flowering in Januaryand due to sudden warm weather conditions the less span was available for crossing work. The flowers according to the plan were crossed and approximately 100 crosses of each combination were made. The fruit set percentage was satisfactory and afterwards a strong series of wind storms causes fruit drop. Only cross of (Sensation x SBChaunsa) was succeeded with two hybrid fruits paving towards its maturity. After that this fruit dropped due to wind storm and immature seed did not show germination. During the previous year three hybrid seedlings of mango were achieved and are flourishing under lath house conditions for their further studies. The hybrid plant of SammarBahishatChaunsa x Sindhri attained the plant height of 160cm while Sindhri x SufaidChaunsapossesses 117cm and Sensation x SammarBahishatChaunsahas 110cm plant height in lath house conditions under intensive care. Nonetheless, during the current year none of the crosses could manage to survive as intensity of natural calamities was much stronger this year as compared to previous years as in (Fig. 3)

Fig.3 Hybrid plants (left to right) SindhrixSafaidChaunsa (A),SufaidChaunsax SB Chaunsa (B), SB ChaunsaxSindhri (C)

5.3. Performance of mango cultivar SammarBahishat Chaunsa on various polyembryonic mango rootstocks

This trial was conducted to evaluate the response of mango cultivar SammarBahishatChaunsa on various polyembryonic rootstocks viz. Carabao Super Manila, Kensington Pride and R2E2. All the mango rootstocks manifested their polyembryonic behavior after germination during previous years. The only nucellar seedlings were selected and when they attained graftable height prolific mango cultivar SammarBahishatChaunsa was grafted on these nucellar seedlings. The polyembryonic mango rootstock Kensington Pride produced vigorous growth than other rootstocks.Polyembryonic plants under each treatment (05) have been transplanted in the field for further studies. Maximum plant height (155cm) was recorded in T_4 where Bullocks Hearts was used as rootstock and in T_3 R2E2 gave (108cm) but in case of T_1Carabao (Super Manila) plant height was minimal (75cm). Number of vegetative flushes per plant in T_4 was recorded (08) whereas six flushes were observed in T_1. The bud wood screening experiment concluded CarabaoLamao and Bullock Hearts manifested tolerant against mango sudden death disease after inoculation with *(Ceratocystisfimbriata)*. Hence, during the current season the seedlings of these tolerant rootstocks were included in this trial and when these seedlings shall attain the graftable height, the scion wood of SammarBahishatChaunsa would be grafted accordingly for further study as in (Fig. 4)

(A)  (B)  (C) 

Fig.4 Performance of mango cultivar SammarBahishatChaunsaon various polyembryonic mango rootstocksi.eBullocks Hearts (A), Kensington Pride (B) and CarabaoLamao (C)

5.4. Survey for the selection of new promising mango varieties

The experiment was long term nature to isolate the chance seedling mango tree having better traits. Survey was carried out in different mango regions and fruits of promising varieties were collected and evaluated for quality attributes. The varieties showed significant behavior were remained under close observation of researchers to explore its characteristics and bud wood was also collected and multiplied in sectional mango nursery for further evaluation. Newly identified mango selections are given as in (Table 1) as well as (Fig. 5 and 6)

Selection Identified	Fruit weight (g)	Peel weight (g)	Stone weight (g)	Pulp weight (g)	TSS Brix)
PREVIOUS SELECTIONS					

Sajjan	320	55	73	192	24.5
FK-2017	470	65	84	321	22.3
NEW SELECTIONS					
Sandeela (Summer)	296	45	54	197	19
Sandeela (Winter)	292	49	56	187	22.5
Haseen	375	46	54	275	23

Table 1. Data profile of promising mango varieties

Fig. 5Fruits of Sandeela crop in summer (A) and winter (B) (above and below)

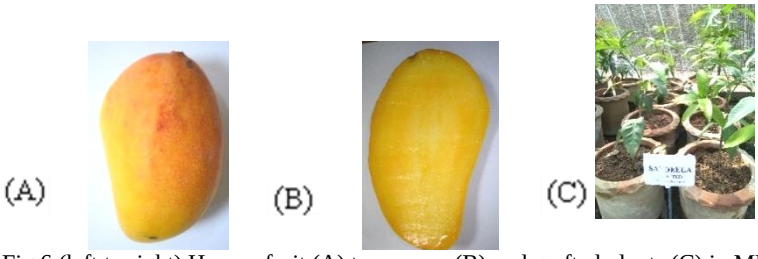


Fig.6 (left to right) Haseen fruit (A) transverse (B) and grafted plants (C) in MRI nursery

5.5. Effect of different chemicals to protect mango seedlings from frost and cold weather injuries

The experiment was scheduled to study the effective treatment against the prevailing frost/cold weather injuries on mango seedlings. Six foliar sprays of different chemicals were applied after fortnight interval starting from 15th November to 15thFebruary. These include control (T_o), H_2O_2 (T_1), Ascorbic Acid (T_2), Salicylic Acid (T_3), and three commercial products Wet-Cit (T_4), Megafol (T_5) and AF-6 (T_6). The data for number of frosty nights was recorded from monthly meteorological data. The performance of T_6 gave good results among all treatments as damage bud sign (01), leaf damage (03) and no bark damage symptoms while second option provide (02) bud damage sign, (04) leaves damage and (01) bark damage sign recorded in the experiment as shown in (Fig. 7)

Fig.7 Effect of different chemicals to protect mango seedlings from frost and cold weather injuries

5.6. Identification and evaluation of various available pot media ingredients for clean mango nursery plants

The experiment was planned in order to identify the various crop residues to be utilized as potential pot media ingredients. Pot media play an important role in success of mango nursery. Local available and cheap source was identified which has potential for utilization in as source of pot media ingredients. The crop residues were identified as T_1 Sugarcane baggasse, T_2 Sunflower heads, T_3 Leaf litter, T_4 FYM, T_5 Corn cob, T_6 Wheat straw and T_7 Rice straw. These media ingredients were grinded and divided into three categories as coarse particles (>5mm) after sieving, medium particle (>5 and <3mm) while fine particles (<3mm). The pot media physical and chemical properties depend on particle size of the ingredients. Maximum electrical conductivity was recorded in Sunflower head of all particles size as 13.76dSm^{-1} while minimum was recorded in Sugarcane baggasse in all particles size <1.21dSm^{-1}. Every media ingredient has advantage and disadvantage over other in some physical and chemical properties. The future prospects of this experiment will be utilization of these ingredients in various proportions to search our suitable combination of mango nursery plants as (Fig.8)

Fig. 8 Different potting media showing different particle size categorized as coarse (A), medium (B) and fine (C)

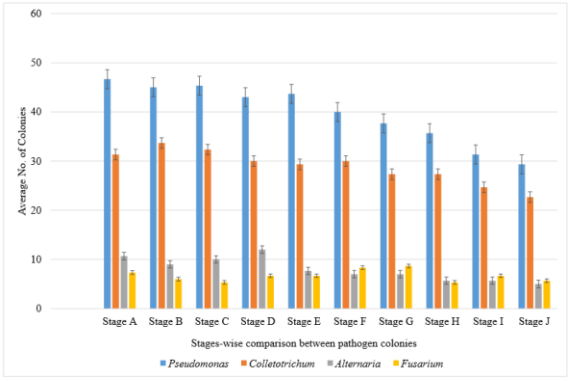
6. PLANT PATHOLOGY SECTION

6.1 Investigation and management of apical necrosis as new bacterial threat to mango orchards

The study was conducted to survey and collect diseased floral buds from tree orchards. Symptomatic buds were exercised in small pieces and cultured on PDA and Kings's Agar B media. Associated pathogens were identified as *Pseudomonassyringae*Pv*syringae*, *Fusariummangiferae*, *Colletotrichumgloeosporoides* and A*lternaria* spp. Identification was carried out on the basis of morphological characteristics and

standardized protocols. Infection frequency of associated pathogens was calculated. *Pseudomonas syringae*pv.*syringae* was the most frequently isolated pathogen at each flowering stage. Infection frequency of *Pseudomonas syringae*pv.*syringae* was maximum 93.33% at stage A(Fig 9(A).Confirmation of the capability of the *Pseudomonas syringae*pv.*syringa*e to cause the disease was done following the Koch's postulates in both the conditions *in-vitro* and *in-vivo*. Infection frequency of each isolated pathogen was correlated with environmental factors. In case of *Pseudomonas syringae*pv.*syringae* ,it was concluded that pathogen infestation was highly favored by high humidity and low temperature. It was also noticed that rain fall also highly correlated with pathogen infestation. It was also observed that correlation between infection frequencies of *Pseudomonas syringae*pv. *syringae* and relative humidity was positive maximum while the correlation was negative maximum with temperature(Fig.9 (B&C). Evaluation of six bactericides viz: Copper hydroxide, Copper oxy-chloride, Streptomycin, Streptomycin sulphae, Kasugamysin and elemental /sulphur + Copper sulphate*in –vitro* through food poisoning technique was done as chemical management of this menace and concluded that Copper hydroxide was most effective at 200 ug/ml concentration. Experiment was conducted under completely randomized design (CRD) with five replications for each treatment. It was concluded that *Pseudomonas syringae*pv. *syringae* bacterium was isolated from each flowering stage A to J. The predominant bacteria were tested as Gram negative. This bacterium was found pathogenic tested through Pathogenicity test. Copper hydroxide was evaluated as best bactericide to control it as shown (Graph .1 A-D

A



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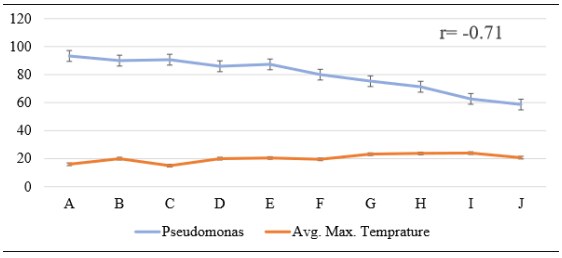

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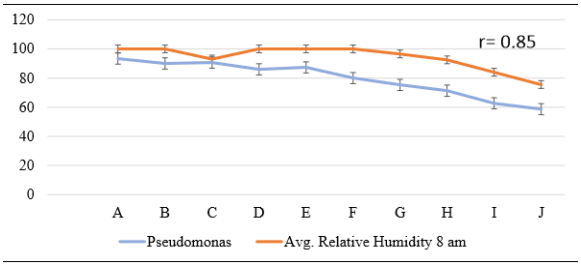
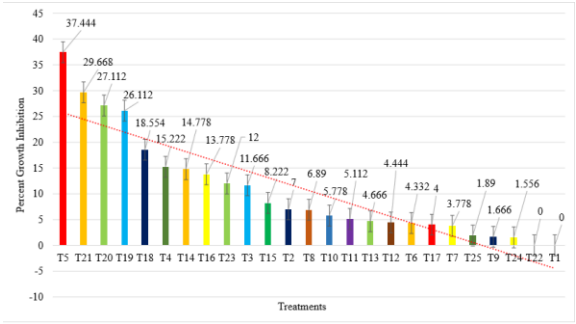


D



Graph 1. (**A**) Various pathogens isolated from mango flowers at different stages from A to J.(**B**) Indicates negative correlation between infection frequency of bacterium Pseudomonas and Temperature.(**C**) Indicates positive correlation between infection of Pseudomonas and Relative Humidity. (**D**) Inhibition of bacterial growth using various chemicals

6.2 Impact of environmental variables on floral diseases of commercial mango varieties.

This study was initiated during the current spring season to check the effect of environmental variables such as temperature, humidity, rain fall on floral disease development of mango. The study was conducted in Multan and Vehari districts. Varieties such as Langhra, Doshari, Ratol, Sindhri and SufaidChaunsa were included in study. The metrological data were recorded on daily basis from Central Cotton Research Institute, Multan, websites and weather stations installed in respective district. The data related to diseases incidence of Blossom Blight, Apical necrosis and powdery mildew were recording after fifteen days as (Fig. 9)

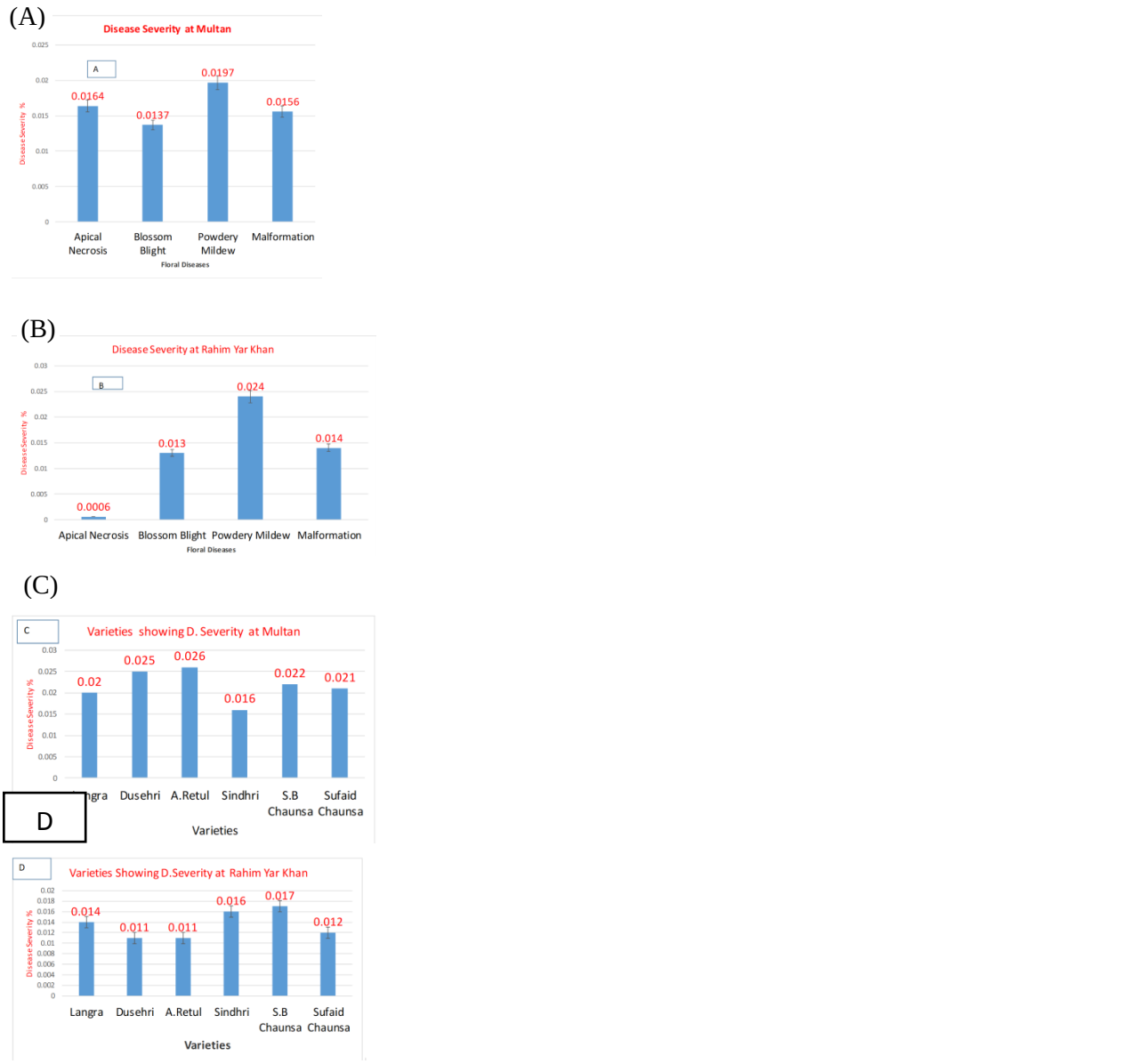


Fig.9 (**A**) Disease Severity of various floral disease of mango at Multan.(**B**) Disease Severity of various floral disease of mango at Rahim Yar Khan.(**C**) Disease severity in various mango cultivar at Multan. (**D**) Disease severity in various mango cultivar at Rahim Yar Khan

6.3 Mango floral disease detection using image processing technique.

The study was designed to devise a quick disease diagnosis system by using image of diseased plant parts Fig (9) (B). The images of diseased plant parts showing unique/ distinguishing symptoms were taken for incorporation into a database for analysis MAT Lab.

The branches on mango trees were tagged and Image of floral diseases such as powdery mildew and blossom blight and mango malformation were collected from various orchards at various development stages of disease. The said study was also started during the current spring season.

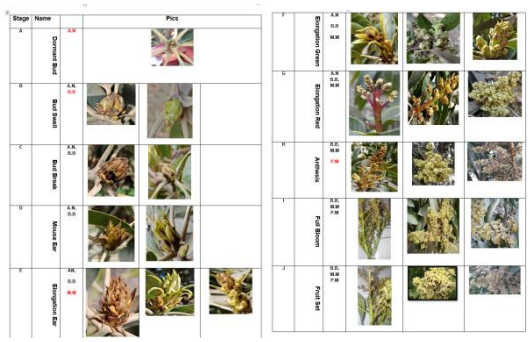


Fig.9 (**B**) Pics of mango diseases from flower stages A to E(**B**) Pics of mango diseases from flower stages F to J.

7. PLANT NUTRITION SECTION

7.1 Assessing efficiency of Phosphorus and Biochar on growth and root development of young mango plants

Phosphorus is a limiting nutrient for plants and an essential element for all life on Earth. The low phosphorus availability in tropical and subtropical soils, normally related to adsorption of phosphate to the minerals surfaces, can be attenuated when organic matter (OM) accumulates in the soils. As the resources of phosphate rock are depleting, new management tools for environmentally friendly P fertilizers are needed. In order to achieve this, recent studies have proposed to use biochar, a carbon-rich solid product of thermochemical conversion of biomass with minimal or zero oxygen supply, with slow-release P fertilizer. However, the effects of biochar on plant-available P in soils have been reported to be variable. The objective was to study the effects of phosphorous with biochar application on nutritional and developmental aspects of young mango plants. The mango plants were evaluated by soil chemical analyses, leaf chemical analyses and physical examination of plant growth. Having this in view, an experiment was set up during 2018 on mango plants, approximately two years old. The treatments applied were: Control (No P and biochar), 15g/plant P + 25g/plant Biochar, 30g/plant P + 25g/plant Biochar, 45g/plant P + 25g/plant Biochar, 15g/plant P + 50g/plant Biochar, 30g/plant P + 50g/plant Biochar, 45g/plant P + 50g/plant Biochar. Experiment was laid out in RCBD with three replications. Recommended dose of nitrogen and potash was applied during the month of August and March in two splits. Phosphorus was applied during August. Biochar was applied during December. Loam textured soil was marginally saline and sodic (EC 2.99 dSm-1 and pH 8.59) with slightly deficient P (7.91ppm), K (190ppm) and organic matter (0.61%).

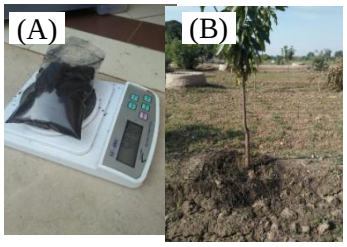


Fig 10.(A) Biochar weighing and (B) application to treatment plant

7.2 Role of cotton sticks biochar in combination with nitrogen rate on yield and nitrogen use efficiency in mango plants CV alishan

Biochar is a carbon rich product being used in production of many horticultural crops; the production of quality planting material is the key to enhance the yield and quality of the crops. Nitrogen is an essential nutrient, and research to date shows that biochar potentially has the ability to manipulate the rates of N in soil by influencing the use efficiency through enhancing availability to plants. A surplus of nitrogen fertilizer can reduce plant nitrogen use efficiency however, biochar can improve nutrient uptake by altering soil properties and root growth. Biochar with nitrogen fertilizers have attracted increased attention, because it can improve the soil fertility, promote plant growth and crop yield. Therefore To promote the growth and yield of mango plant with high uptake of nutrients a study was planned on mango plants CvAlishan. The treatments applied were: T1= Control (No N and biochar), T2= 1.5kg/plant N + 0.5kg/plant Cotton Stick biochar, T3= 2.0kg/plant N + 0.5kg/plant Cotton Stick biochar, T4= 1.5kg/plant N + 0.75kg/plant Cotton Stick biochar, T5= 2.0kg/plant N + 0.75kg/plant Cotton Stick biochar, T6= 1.5kg/plant N + 1.0kg/plant Cotton Stick biochar, T7= 2.0kg/plant N + 1.0kg/plant Cotton Stick biochar. The experiment was laid out in RCBD with three replications. During December lay out was completed and biochar was applied. The average fruit retention (0.59 %)and fruit weight (240g) was found in treatment where 2.0kg/plant N + 0.75kg/plant Cotton Stick biocharwas applied.

(A) (B)

Fig 11. Harvested labeled fruit ready for washing in lab and further procedures

7.3 Impact of plant growth promoting rhizobacteria coated n fertilizer on the yield and nutrients uptake in mango plants Chenab gold

Nitrogen is a critical limiting element for plant growth and production. It is a major component of chlorophyll, the most important pigment needed for photosynthesis, as well as amino acids, the key building blocks of proteins. Even though it is one of the most abundant elements, plants can only utilize reduced forms of this element. Plants can readily assimilate NH_3 to produce the aforementioned nitrogenous biomolecules through nitrogen fixing bacteria. Therefore artificial application of nitrogen fixing bacteria mixed with nitrogen fertilizer and bacteria coated fertilizers were applied in different combinations to see the impact on plant growth in mango cv. Chenab Gold. The following treatment plan was adopted. T1= Uncoated @ 100% recommend N rate, T2= PGPRs coated N @ 50% recommended N rate, T3= PGPRs coated N @ 75% recommended N rate, T4= PGPRs coated N @ 100% recommended N rate, T5= NFB bacteria + N @ 50% recommended N rate, T6= NFB bacteria + N @ 75% recommended N rate, T7= NFB bacteria + N @ 100% recommended N rate. Maximum fruit retention (0.85 % and .83 %) was recorded where PGPRs coated N @ 75% recommended N and NFB bacteria + N @ 75% recommended N were applied respectively.

Fig 12. (A) Collection of Soil Samples and (B) Treatment application to respective plants according to lay out

7.4 Impact of boron application times on mango fruit setting, retention and fruit quality in mango cv. sufaidchaunsa

A study was planned to evaluate the effect of B application times, on fruit setting per panicle, fruit retention percentage and fruit quality in mango plants. Three different times of Boron application evaluated were: Before bud initiation, fruit setting and pre harvest stage of fruit. Two application methods (soil and foliar) were adopted to test the difference (if found) with four repeats and RCBD statistical design on CV Chaunsa White. The treatment plan was as following: Control (T_1), Foliar spray of Boric Acid 0.08 % before bud initiation (T_2), Foliar spray of Boric Acid 0.08 % before fruit setting (T_3), Foliar spray of Boric Acid 0.08 % pre harvest of fruit (T_4), Soil application of Boric Acid 60g/plant before bud initiation (T_5), Soil application of Boric Acid 60g/plant before fruit setting (T_6) and Soil application of Boric Acid 60g/plant pre harvest of fruit (T_7). Befo2re application of treatments, basic analysis of soil samples conducted. Loam textured soil was free from salinity and sodicity hazards (EC 2.40 dSm^{-1} and pH 8.05) hazards with optimum P (8.12ppm), K (190ppm) and B (0.51ppm) contents and low in organic matter (0.55%). Pre-treatment application data of leaves indicated the deficient concentration of B (17ppm). The results after treatment application revealed that maximum number of fruit set per panicle (44), fruit retention (0.48 %), fruit weight (395g), and Yield (131kg/plant) was recorded in treatment where soil application of boric acid 60g/plant before bud initiation was carried out following, soil application of boric acid 60g/plant before fruit setting respectively. Moreover highest value of TSS (23.1Brix^{o}) and shelf life (14 days) was found in the same treatment where boric acid @ 60g/plant before bud initiation applied.

Fig. 14 De-sapping of fruit samples in lab (a and b) soil samples prepared for reading of P (c) P reading taken on on spectrophotometer at 882 nm wavelength (d)

7.5Standardization of nutritional requirements of die back affected plants in SammerBahisht Chaunsa with integrated approach

An experiment was planned to rehabilitate the diseased plants (dieback affected) with chemical fertilizer as well as organic manures through improving nutrient use efficiency and standardize the nutritional requirements of these plants in cv. Chaunsa SB to set a yardstick for further application. Four types of organic sources viz; FYM, City Waste, Poultry Manure, Press Mud and elemental Sulfur were applied with recommended doses of NPK with three replications and RCBD statistical design. Treatments were: Recommended dose of NPK (T_1), RD of NPK + FYM (T_2), recommended dose of NPK + City Waste (T_3), recommended dose of NPK + Poultry Manure (T_4), recommended dose of NPK + Press Mud (T_5), recommended dose of NPK + Sulfur (T_6). NPK were be applied according to the recommendations during the months of July-August and Feb-March and in the subsequent years the fertilizers will be applied according to soil and leaf analysis report. Organic sources were added on the basis of organic matter contents during the month of December, while the micronutrients were supplied to all treatment plants as foliar spray at recommended time of application. Plants of same age were selected. All the cultural practices required for mango were maintained. Basic analysis of soil samples was conducted. Loam textured soil was marginally saline and sodic (EC 2.99 dSm-1 and pH 8.59) with slightly deficient P (7.91ppm), K (190ppm) and organic matter (0.61%). Before application of treatments leaves were analyzed for NP and K. Low level of N, P and K was observed (0.58, 0.11, 0.38 %) respectively. After application of treatments, significantly lowest disease intensity (0.12%) was observed where recommended dose of NPK + Poultry Manure (T_4) were applied, followed by recommended dose of NPK + Sulfur (0.13%) as (Fig 14)

Fig. 15 shows the different steps of determination of phosphorus and potassium. a) Ammonium Acetate was used for potassium extraction of soil samples. b) The samples were filtered after centrifuging at 1500-2000 rpm for 5 minutes. c) Potassium was determined by Flame Photo Meter

Projects: PARB-904

Title: Nutrition enhancement of crops, fruits, vegetables and their products under climate change scenario

Mango fruit is a rich source of energy, vitamins and minerals but due to unbalanced use of fertilizers and mineral deficiency in our country under current climate change scenario, we have not been able to accomplish the required nutritional values and yield of mango fruit. Therefore, to ensure the availability of all the essential nutrients in fruit, it is required to improve the supply of all essential nutritive elements from soil to fruit by applying the organic and inorganic sources of nutrients in different combinations.

The increase in yield and improvement in nutritional value of the mango fruit are the main objectives of this project. Five orchards from each top mango producing districts (Multan, Muzaffargarh, Bahawalpur, Khanewal and Rahim Yar Khan) in Punjab were selected to collect the soil, leaf, and fruit samples. In these districts, some of the popular commercially grown varieties are Sufaid Chaunsa, SammarBahisht Chaunsa, Sindhri, Dusehri, Langra, and Anwar Retaul. The current nutrient status in soil, leaf and fruit samples in existing nutrient management system of the farmer orchards were tested to draw the baseline of nutrients in soil, leaf and fruit samples in selected mango farms during year I. The collected 543 samples of soil samples were analysed for EC, pH, Olsen P, K, OM, Zn, and Fe while leaf and fruit samples (192) were analysed for N, P, K, Zn, and Fe to determine mineral composition. Fruit samples were also analysed for biochemical parameters (TSS, Acidity, and Beta Carotene). After survey completion, next year three experiments were initiated for biofortification technology development at Mango Research Station Shujabad and JalalpurPirwala on SammerSufaid Chaunsa, Bahisht Chaunsa, and Sindhri, respectively.

Zinc and iron biofortification in mango CV. SB Chaunsa through various organic amendments

The different combination of biochar, compost, peat moss and poultry were applied to increase the availability and uptake of zinc and iron from the soil. The treatments were include: T_1: NPK + Zn(250g)+Fe(350g), T2: NPK + Zn(250g)+Fe(350g) + CB (10:0.1), T_3: NPK + Zn(250g)+Fe(350g) + CB (10:0.2).T4: NPK + Zn(250g)+Fe(350g) + MB (10:0.1). T_5: NPK + Zn(250g)+Fe(350g) + MB (10:0.2), T_6: NPK + Zn(250g)+Fe(350g) + PMB (10:0.1, T7: NPK + Zn(250g)+Fe(350g) + PMB (10:0.2). The initial soil and leaf samples were collected before application of treatments. The fruit samples were collected at maturity in July Fig (16). The recommended NPK, fertilizers were applied after harvest of mango fruit. The Zinc and iron fertilizers dose were applied according to treatment. The organic amendments were applied in December Fig (18). The soil, leaf and fruit samples were analyzed for physiochemical properties. The standard culture practices were adapted from time to time Fig (17) & (19)&(20-21)

Fig. 16 the figures show the preparation of biochar on locally manufactured furnace; a) The cotton sticks and dried banana leaves were used as feed stock. The materials were grinded first before to put in furnace. b) The grinded material was put into furnace for about 45 minutes. c, d) the prepared biochar

Fig. 17 The Fertilizers application process a) The weighing and preparing of treatments wise b) The application of fertilizer under the canopy of tree.

Fig. 18 $NaHCO_3$ preparation for soil P determination, P standards preparation, sample preparation for Soil K extraction

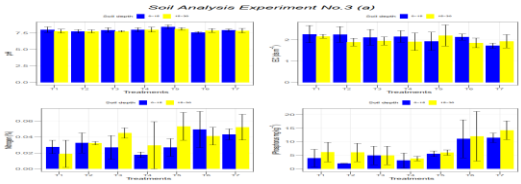


Figure 19 the soil pH, EC, nitrogen, and phosphorus at 0-10 and 10-20cm. The values are mean and standard deviation of three replications.

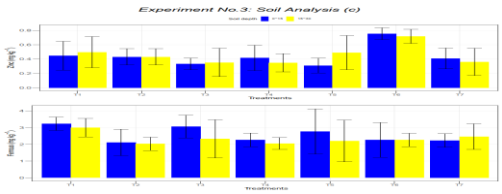


Figure 20 the soil zinc and ferrous contents at 0-10 and 10-20cm. The values are mean and standard deviation of three replications.

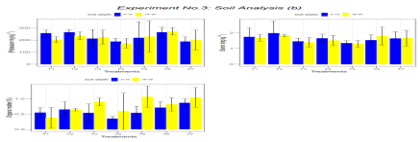


Figure 21 the soil potassium, boron and organic matter contents at 0-10 and 10-20cm. The values are mean and standard deviation of three replications

8. ENTOMOLOGY SECTION

8.1 Off season chemical management of mango hoppers (*Idioscopus* sp.) and its ultimate impact during flowering season.

The experiment was conducted at two different locations i.e. Mango Research Institute and farmer field, Mouzagaraywala, Tehsil and District Multan. The orchard of Mango Research Institute, Multan was sprayed regularly to overcome hopper population whereas the farmer did not spray the orchard during non-flowering stage. The results reported that MRI orchard has zero population of mango hoppers on inflorescence during whole March, 2019. The farmer orchard has mango hoppers population ranging from 3.29 to 11.32 individuals per inflorescence during the month of March 2019 and sprayed (Fig. 22)

Table2. Data regarding population of mango hoppers during flowering and non-flowering stage of mango

Date of observation	Location-1 Mango Research Institute, Multan		Location-2 Farmers field garaywala orchard, Multan	
	Av. population of MH per ft branch/ inflor	Av. population of MH per sq. ft on trunk	Av. population of MH per ft branch/ inflor	Av. population of MH per sq. ft on trunk
5.10.18	0.00	1.45	0.00	10.23
12.10.18	0.00	1.20	0.00	5.12
19.10.18	0.00	0.80	0.00	8.61
26.10.18	0.00	1.12	0.00	6.29
02.11.18	0.00	0.55	0.00	4.32
07.11.18	0.00	0.75	0.00	5.28
13.11.18	0.00	0.30	0.00	3.26
21.11.18	0.00	0.20	0.00	2.10
27.11.18	0.00	0.15	0.00	2.29
3.12.18	0.00	0.25	0.00	1.56
10.12.18	0.00	0.25	0.00	2.19
17.12.18	0.00	0.10	0.00	2.12
23.12.18	0.00	0.05	0.00	2.18
31.12.18	0.00	0.05	0.00	1.55
07.01.19	0.00	0.00	0.00	0.75
14.01.19	0.00	0.00	0.00	0.50
21.01.19	0.00	0.00	0.00	0.25
28.01.19	0.00	0.00	0.00	0.19
4.2.19	0.00	0.05	0.00	0.01
11.2.19	0.00	0.00	0.00	0.00
18.2.19	0.00	0.00	0.00	0.02
25.2.19	0.00	0.00	0.00	0.00
4.3.19	0.00	0.00	3.29	0.00
11.3.19	0.00	0.00	5.70	0.00
18.3.19	0.00	0.00	8.11	0.00
25.3.19	0.00	0.00	11.32	0.00
1.4.19	0.00	0.00	0.00	0.00
06.01.2020	0.00	0.1		

13.01.2020	0.00	0.00		
20.01.2020	0.00	0.00		
27.01.2020	0.00	0.00		
03.02.2020	0.00	0.00		
10.02.2020	0.00	0.00		
17.02.2020	0.00	0.00		
24.02.2020	0.00	0.00		
02.03.2020	0.00	0.00		
09.03.2020	0.00	0.00		
16.03.2020	0.00	0.00		
23.03.2020	0.00	0.20		
30.03.2020	0.00	0.00		
07.04.2020	2.60	0.00		
14.04.2020	15.50	0.00		
21.04.2020	29.30	0.00		
28.04.2020	1.65	0.23		
04.05.2020	4.30	02.95		
11.05.2020	0.00	05.50		
18.05.2020	0.00	07.20		
29.05.2020	0.00	07.20		
02.06.2020	0.00	10.30		
09.06.2020	04.10	09.20		
16.06.2020	0.90	14.00		
25.06.2020	0.75	19.19		

Fig.22. (A) Data regarding population of mango hoppers during flowering and (B) non-flowering stage of mango

8.2 Evaluation of different insecticides for management of leaf blotch miner (LBM) (*Acrocercopessyngramma*) on mango plants.

The experiment was conducted at Mango Research Institute, Multan during the peak activity of leaf blotch miner in October, 2018. The results reported that maximum mortality of LBM was recorded by the applications of insecticides Belt and Boltan having 72.73 and 70.59 percent mortality 3 days after spray. Whereas, 5 days after spray Belt, Coragen and Rashim gave maximum mortality of LBM i.e. 87.11, 81.29 and 80.19 percent mortality Fig (23). After 7 days of spray Belt, Coragen and Rashim gave good mortality 89.79, 83.12 and 81.23 percent.

Table 3. Data regarding mean percent mortality of leaf blotch miner

Treatments	Dose/ 100 L	Mean	Mean % mortality of LBM after

Trade Name	Common name		population/ leaf of LBM	3 days	5 days	7 days
Karate 2.5EC	lambdacyhalothrin	100ml	23	60.87	67.12	71.23
Match 50EC	lufenuron	100ml	25	48.00	52.34	55.43
Belt 480SC	flubendiamide	25ml	11	72.73	87.11	89.79
Coragen 20SC	chlotranilirole	50ml	16	62.50	81.29	83.12
Boltan 31EC	gammacyhalothrin+chlopyrifos	300ml	34	70.59	73.24	79.83
Decis super 100Ec	deltamethrin	50ml	10	60.00	62.38	68.21
Rashim	bifenthrin	100ml	44	65.90	80.19	81.23
Emamectin 1.9EC	emamectin benzoate	100ml	18	66.67	73.28	74.14
Nitenpyram	nitenpyram	150ml	14	21.42	24.53	25.11
Control		-	22	0.00	0.00	0.00

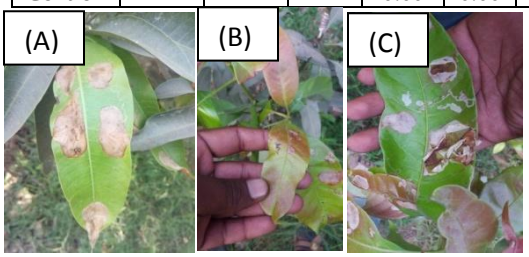


Fig. 23 Evaluation of different insecticides for management of leaf blotch miner (LBM) (*Acrocercopessyngramma*) on mango plants.**(A)** Damage of LBM **(B)** Blotch of LBM **(C)** Larvae of LBM (*Acrocercopessyngramma*) on mango plants

8.3 Exploitation of quantitative studies pertaining to mango fruit fly

This study was conducted to assess the infestation and species occurrence. The fallen fruits under each experimental plant were also collected on daily basis for the same purpose. Susceptibility level for each variety was examined with the keen observation of apparently infested fruits on the tree followed by the dissection and rearing in the laboratory. It was found that 45-70% fruit drop in these varieties at maturity

stage was only due to attack of fruit fly. Cv. Sindhri was observed more prone to fruit fly with the highest larval infestation percentage by 18.75 followed by 10.52 and 8.34 percent in cultivars Chaunsa (SB) and SufaidChaunsa respectively Fig (24). Two species named *Bactrocerazonata* and *Bactroceradorsalis* were predominantly prevalent in experimental orchard by 93.38 and 6.62 percent respectively with sex ratio of 3:1 for both species. The new inquiry in hand will be useful to stream line the management strategy against this challenging insect pest in Pakistan in (Tab. 4-5-6)

Tab. 4 On-tree inspection

Variety	No. of inspected fruits	No. of suspected fruits	No. of fruits cut	Fruits attacked		%age attack
				Yes	No	
Sindhri	300	32	32	6	26	18.75%
Chaunsa	400	57	57	6	51	10.52%
ChaunsaSufaid	400	63	63	4	59	8.34%

Tab. 5 Inspection of dropped fruits

Variety	No. of Dropped fruits	No. of suspected fruits	No. of fruits cut	Fruits attacked		%age attack from total dropped fruits
				Yes	No	
Sindhri	47	47	47	25	22	53.19%
Chaunsa(	73	73	73	55	18	79.34%
ChaunsaSufaid	66	66	66	43	23	69.15%

Tab. 6.Rearing of fruit fly in laboratory

Variety	No. of Pupae placed in cage	Adult emergence					
		B. zonata			B. dorsalis		
		M	F	Total	M	F	Total
Sindhri	168	07	50	57	06	01	07
Chaunsa (SB)	413	111	235	346	03	09	12

Chaunsa Sufaid	328	21	112	133	06	13	19
Total	909	139	397	536	15	23	38

(1) Adult emergence from Pupae after rearing in Laboratory:
57/909 X100 = 63.14%

(2) Sex Ratio

Female	:	Male
420/574 X100	:	154/574 X 100
73.17%	:	26.83%
3	:	1

(3) Ratio of different species in newly emerged adult Flies

B. zonata	:	***B. dorsalis***
536/574 x 100	:	38/574 x 100
93.38%	:	6.62%

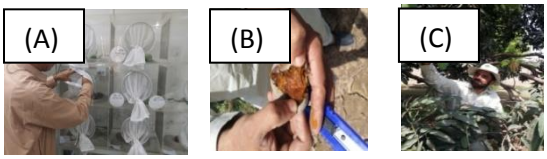


Fig. 24.Exploitation of quantitative studies pertaining to mango fruit fly. A) Fruit samples in cages (B) Larvae of fruit flies (C) Checking hanging infested fruits by fruit flies Exploitation of quantitative studies pertaining to mango fruit fly

9. POST-HARVEST SECTION

9.1. Standardization of maturity indices of promising mango varieties

A research trial was conducted on three different cultivars i.e. Aalishan, Chanab Gold and Azeem Chaunsa in order to find out the most suitable time for harvesting of fruits of each variety. The treatment

T_1(Aalishan), T_2 (Chanab Gold) and T_3 (Azeem Chaunsa) were harvested at four different maturity stages of fruits. T_1 (Aalishan) was harvested at 80, 90, 100 & 110 days after fruit setting. Similarly T_2 (Chanab Gold was harvested at at 100, 110, 120 & 130 days while T_3 (Azeem Chanusna) at 120, 130, 140 & 150 days from fruit setting. Different quality attributes of fruits were tested in post-harvest laboratory of MRI Multan.The data revealed that the harveste fruits of Aalishan, Chanab Gold and Azeem Chaunsa at maturity stages of 90, 120 and 140 respectively were observed relatively better in color development, TSS (22.9, 18.5 and 23.4), acidity (0.23, 0.18 and

0.22%) and shelf life (7, 7 and 8 days) respectively. At harvesting stage the TSS of T_1, T_2 and T_3 exhibited 9.5%, 9.2% and 8.2 % TSS while firmness was 9.0, 8.9 and 9.5kg accordingly Fig(25).

Figure.25. Mango fruits glimpse at maturity stage a) Aalishan b) New Sinhari& c) Azeem Chaunsa

9.2. Effect of pedicle removal at different length with reference to anthracnose and stem end rot development in mango cv. S.B. Chaunsa

A research trial was conducted to find out the impact of pedicle removal on the incidence of different postharvest diseases i.e. stem end rot and anthracnose. For this purpose, mature fruits with different pedicle lengths i.e. 0 cm, 1 cm, 02 cm, 03 cm & 04 cm were harvested and placed at ambient temperature for ripening. The appearance and severity of above mentioned disease were checked on daily basis. It was found that the fruits were harvested along with pedicle length of ≥ 02 cm were more resistant to above mentioned disease as compared to the fruits with pedicle lengths of 00 cm & 01 cmFig (26).

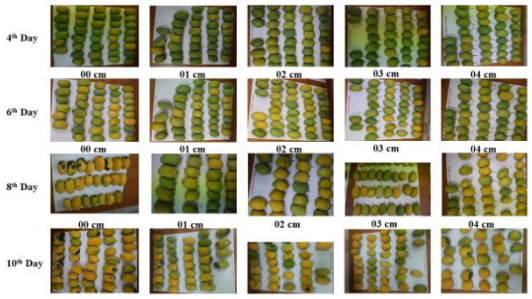


Fig.26 The severity of anthracnose & stem end rot on pedicle removal at different length with two days interval after harvest

9.3. Study on efficacy of different bagging materials for the control of foreign entities on different mango cultivars

Study on efficacy of different bagging materials for the control of foreign entities on different mango varieties to produce their quality fruit was conducted at Chanab Mangoes Farm JalapurPeerwala during 2019. Different bagging material including brown paper, non-woven, butter paper, muslin cloth and brown paper with inner carbon layer were used on mango Cvs. Sindhri, SB Chaunsa, Azeem Chaunsa and Sufaid Chaunsa. After bagging the fruits of each variety were harvested at their maturity and data were recorded regarding weight, physical appearance (color), incidence of postharvest diseases, insect

pest damage, heat injury and fruit drop. No significant difference regarding the weight of mango fruits of all the varieties were observed amongst the treatments. Bagging with brown paper resulted in the whitish green color in all the varieties at maturity stage. Similarly at ripening stage, brown paper was ranked 1st due to reflection of deep yellow color. The results of the heat injury and chemical analysis remained at par and no significant difference was observed between control and rest of treatment. Infestation of fruit fly and incidence of postharvest diseases like anthracnose and stem end rot were also minimum on the fruits of all the varieties wrapped paper. The data of fruit drop was very amazing and it was maximum in the treatmentwhere brown paper was used followed by the control treatment. Concisely, brown paper showed the desirable results in the preliminary study of bagging material Fig (27).

Figure 17 Mango fruits glimpse after treatments

10. ANNUAL TECHNICAL REPORT, 2019-20

Mango Research Station, BastiMalook road Shujabad.
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OVERVIEW:

Mango (*Mangiferaindica*L.) is a most important tropical and subtropical fruit grown in more than 90 countries of the world. It is the second major fruit crop in Pakistan after citrus and being grown on 169 thousand hectares with annual production of 1685 thousand tons of fruit. Almost 200 mango varieties are being grown in Pakistan and among these about 30 varieties are well known in the markets. Chaunsa Samar Bahisht, Sindhri and Sufaid Chaunsa are leading varieties holding 80% area under cultivation. In Pakistan this fruit is mainly grown in the province of Punjab and Sindh. Mango in Sindh mature almost one month earlier than Punjab which extend the mango marketing period significantly. Pakistan falls in

top five mango producing countries but export is less than 10 percent of total produce. The export needs to be extended up to 20% of total produce to fetch maximum foreign exchange and to stable the fruit prices in local market. Similarly the pulp industry may also be strengthened to absorb 20% produce having low quality. The weakness in, basic infrastructure, unavailability of healthy nursery plants, limited exportable varieties and capacity at farm level are the major hurdles, lack of information regarding foreign market requirements and trade linkages deficit are the other hurdles which needs to be addressed.

The priority of the government and focus of institutes to enhance the export may change the whole situation in coming few years and mango cultivation of Pakistan flourish in near future to become an industry.

10.1. Documentation and study of different traits of mango germplasm

In the fruit plants, three established methods, i.e. Selection, introduction and breeding are adopted for the evolution of new varieties. Selection and introduction are more victorious and creative methods as all the commercial cultivars of the country have come into existence from selection of the naturally selected available material.

During survey and selection of promising mango strains, one mid-season variety "Chenab Gold" was identified six years ago in Jalalpur and one late season variety Azeem Chaunsa was also identified from Uch Sharif in the same year. Two years data for Azeem Chaunsa and Chenab Gold were completed and presented in FSC&RD for DUS test. DUS test for 2019 regarding leaf, flowers, plant characteristics and fruit characteristics were completed by FSC&RD on 23.07.2019 & 06.09.2019 for Chenab Gold and Azeem Chaunsa respectively and same will be repeated next year.

Some important aspects of the data recorded in last three year from the selected plants at grower's field are given as under.

Chenab Gold: The Fruit size is large i.e. 400-750 gm, flesh firm and deep yellow. Skin is extremely shining and attractive. The fruit mature in mid-July and can be kept on the tree till 1st week of August. The plant is regular in fruiting with good average yield (350 kg per plant). The fruit has extended shelf life(Fig1).

Fig. 6.1- Chenab Gold - Fruit on plant

Fig. 6.1- Chenab Gold-ripened Fruit

Azeem Chaunsa: Late season variety with medium fruit size and having extended shelf life. Fruit mature during last week of August and can be kept on the plant till October last week. The average plant yield is 550 kg fruit per plant.(Fig. 6.2).

Fig. 6.2- Azeem Chaunsa-Ripened Fruit

Both varieties have well on tree storage ability, compact flesh and extended shelf life and these are spreading rapidly among growers and their export share is increasing

10.2. Effect of climate change (high & low temperature) on flowering and fruiting behavior in commercial cultivars of Mango.

Increasing temperature and effects of greenhouse gases are the most important issues associated with climate change and it may affect production and quality of fresh fruits directly and indirectly. In mango temperature has a main influence on the growth cycle, time and frequency of flowering, fruit growth, taste and appearance of the mango fruit. Vegetative growth and fruit growth require comparatively higher temperature while inflorescence emergence and fruit setting needs moderate temperature.

Prime objective behind this experiment is to find out the impact of changing climate i.e. high temperature, low temperature and fog on the flowering and fruiting behavior of various commercial mango cultivars. In this experiment one commercial orchard was selected each at 3 different locations i.e. Multan, Vehari & Rahim Yar Khan. The data were collected on daily basis regarding fog (November to Mid-March), low temperature (November last week to Mid-March). The frost damage and flowering

intensity was recorded in March 3rd week at the time of peak flowering (20 location on each plant all around the tree) for the year 2019. (Tabel6.1.)

Treatment	Variety	Terminals (Frost affected)	Flowering terminals (%)	Sunburn Fruit %
T_1	Dusehri	0	94	2
T_2	Sindhri	0	83	7
T_3	Chaunsa (SB)	0	87	6
T_4	Chaunsa Sufaid	0	69	18
T_5	Retaul Late	0	89	4

(Table 01)Effect of climate change (high & low temperature) on flowering and fruiting behavior in commercial cultivars of Mango.

Moderate frost was observed only for one day on 25.01.2019 and fog was recorded for 7 days. No sever damage by frost and fog have been recorded in winter. However, the extended winter increased the flowering in all varieties. The maximum temperature was observed from 28th May to 03 June (46-48^{o}C) which affected the fruit in all varieties. Maximum Sunburn was recorded in Sufaid Chaunsa (18%) and Sindhri (7%) and minimum effect could be seen in Dusehri (2%) and Retaul Late (4%).

10.3 Evaluation of polyembryonic root stock for commercial mango cultivars of punjab.

Prime objective of this effort is to provide, homogeneous rootstock (Polyembryonic) for mango industry of the country, useful against different abiotic stresses. For this purpose the bud wood of 37 Polyembryonic mango varieties were imported during in 2008-2010 from Australia (which are being used as rootstock in different parts of the world) for utilization as a rootstock. Out of these 37 varieties 24 varieties remained successful. All varieties have produced the crop this year. The stone of these 24 varieties were sown in July, 2019 to check their polyembryonic behavior. **Out of 24 varieties, only 03 i.e. 13-1, Australian Common and R_2E_2 were found polyembryonic** while remaining 21 varieties were found monoembyonic.The 15 varieties which were found polyembryonic last year remained monoembryonic this year namely **Kaew, Banana Long, Xoai Cat HoaLoc, Brown's Seedling, Olour, Carabao Super Manila, Xoaitoung, indo Chinese late, Kensington Pride, Kuru, Bullocks Heart, Kastori, XoaiBoui, Rosa and Rockdale Siagon. One variety R_2E_2 found polyembryonic this year which was monembryonic last year.** So varities are changing theirbehavior from year to year. (Fig. 6.3)

Fig. 6.34-plants growing form one stone

Fig. 6.3- All seedlings have independent root system.

The commercial varieties will be grafted on these root stock for further evaluation against salinity, drought and fruiting behavior. It is added that one variety 13-1 has strong polyembryonic behaviors, (3-5 plants from a stone) and a well-known rootstock against salinity and may be useful for local mango industry.

10.4 Standardization of hot water dip duration to check infestation of fruit fly in mango fruit.

This experiment was designed to find out the appropriate duration for hot water dip of mango fruit to kill fruit fly eggs and maggots in different varieties of mango. 50 fruits were harvested at proper maturity for each variety.Harvested fruits were handed over to Professor Dr. SahfqatSaeed at MNSUA, Multan wherefruits remained under fruit fly egg laying process for 24 hours.The fruit was shifted back immediately at MRS, Shujabad for HWT. The temperature of Hot Water was maintained at 48^{o}C for each variety before putting mango in it, in the presence of Dr. ShafqatSaeed or his representative. After hot water dip the fruits were placed at ambient temperature to settle down the fruit temperature.Then fruits were allowed to ripen in traditional packing (7-9 days). The infestation of fruit fly was checked at the time of ripening of the fruit and infected fruits were counted accordingly. While the fruits under T_1 were remain at MNSAU, Multan for inspection at ripening and jointly inspected by the research workers (Table 2).

Variety	**T_1** **(Control)**	**T_2** **(10 minutes)**	**T_3** **(20 minutes)**	**T_4** **(30 minutes)**	**T_5** **(40 minutes)**	**T_6** **(50 minutes)**	**T_7** **(60 minutes)**	**T_8** **(70 minutes)**
Sindhri	100 % contamination	1	0	0	0	0	0	0
Chaunsa S.B.	100 % contamination	0	0	0	0	0	0	0

Chaunsa white	100 % contamination	2	0	0	0	0	0	0

(Table 2)Standardization of hot water dip duration to check infestation of fruit fly in mango fruit.

The results recorded reflect that fruit fly infestation in fruits for all varieties after ripening has been observed 100 % under T_1. While in Sindhri& Chaunsa White fruit fly infestation was observed in T_2 only and fruits under the remaining treatments for all varieties remained free from infestation of fruit fly while Chaunsa S.B. remain clean even under T_2. Therefore, it can be concluded that the hot water dip duration of 20 minutes is equally safe to control fruit fly in these varieties when water temperature is keptat 48^oC.

10.5Induction of post harvests vegetative growth in mango cv. chaunsa (s.b) by using different chaemicals.

This experiment was initiated to induce vegetative growth immediately after harvesting by spraying certain chemicals / nutrients. Chaunsa SammarBahisht is very popular variety for domestic and foreign markets but the variety has strong character of alternate bearing; the main cause is lack of vegetative growth after harvesting which is the principal base for next year fruiting. This experiment has been designed to overcome this issue: by inducting after harvest vegetative growth immediately after harvesting. The post-harvest growth achieved under different treatments and its flowering behavior in Table 3

Treatments	**Growing terminals (%)**	**Flowering (%)**	**Yield (kg)**
T_1 (Control)	38	43	98
T_2 (Urea 2 %)	42	46	135
T_3 (KNO_3 1%)	51	60	170
T_4 (KNO_3 2%)	57	65	190
T_5 (Urea2%+$KNO_3$1%)	47	56	149
T_6 (Urea2%+KNO_3	48	48	139

%)			

(Table 3)Induction of post harvests vegetative growth in mango cv. chaunsa (s.b) by using different chaemicals.

The data shows that maximum growing terminals (57%) after harvest were produced in T_4 (2% KNO_3) while, minimum growing terminals i.e. 38% were recorded under T_1. Almost same trends were observed for flowering terminals and yield. The maximum yield (190kg) was recorded under T_4 and minimum yield (94 kg) were found under T_1.

10.6 Factors involved in the development of viviparity phenomenone in late maturing mango cultivar sufaidchaunsa.

Vivipary is the phenomenon whereby the embryo grows from the mango stone when fruit is on the tree or ripe. This experiment was designed to find out the time period (week) when vivipary disorder initiate and also find out the major factors which facilitate and encourage this disorder.For this purposefruits were collected (50% normal size & 50% large size) and allowed to ripen according to standard procedure (wrapping in newspaper and keeping at ambient temperature). At fruit ripening each fruit was checked for embryo growth or root development. The management practices regarding nutrition (Post harvest & flowering) and irrigation was also recorded w.e.f. February to last harvest to establish linkage with the disorder if any as shown in Table (4).

Treatment	**Fruit Checking (date)**	**Ave Fr. Wt. (gm)**	**Fruit showing growth under each orchard (8 fruits)**		
			I	**II**	**III**
T_1	25.08.2019	477	2	1	1
T_2	01.09.2019	463	2	1	1
T_3	10.09.2019	531	3	2	2
T_4	17.09.2019	495	4	1	2
T_5	26.09.2019	510	3	2	4
T_6	02.10.2019	540	5	3	4
New orchard	11.10.2019	531	All clear		
Total			19	10	14

Table 4.Factors involved in the development of viviparity phenomenone in late maturing mango cultivar sufaidchaunsa

The fruits were harvested from all three orchards on the same day and allowed to ripe at ambient temperature. The fruits were inspected at ripening i.e. on 7th or 8th day after harvesting. Slight root growth observed in 4 fruits under T_1& T_2 and found sever (13) in first week of October in T5 (Table 4). So, the issue become severs with the passage of time. As the irrigation in different orchard is concerned it was recorded as 19, 10 and 14 in orchard 1,2 and 3 respectively. The minimum irrigations were observed with minimum vivipary and maximum disorder was noted in orchard-1. It is worth mentioning that 8 fruits were collected from another orchard on 11.10.2019 and no root growth was observed anyhow slightly embryo was visible and this orchard faced water stress throughout the fruit growth period due to non-availability of water.

11. **OTHER DEVELOPMENT ACTIVITIES**

1.	Radio Talks	10
2.	TV Talks	02
3.	Capacity Building Program	10
4.	Seminar	05
5.	Urdu/English Articles	07
6.	Farmer Gathering	12
7.	Conferences	02
8.	Class Visited	08
9.	Internee/M.Sc.	16
10.	Special Meetings	04
11.	Grower Visited	211
12.	Orchard Visited	30
13.	Mango nursery plants sold	5211

Other activities (MRS, Shujabad)

1. Participation in mango exhibitions 2
2. Mango nursery plants sold9480

12. RESEARCH PUBLICATIONS

Full length Papers

1. Idrees, S., S. Chohan, M, Abid ,R. Parveen, M.T.Mlik. Biological Potential of Trichoderma Species in the control of some Phytopathogenic Fungi. (2019).Pak.J.Phytopathol.,Vol.31 (02).201-206
2. Kiran, S., Bakhsh, A,Iqbal, J, Iqbal,Raza, S,Ahmad, N, Ali, M. A and Danish, S. (2019).Effect of changing weather on success of wedge and veneergrafting and chlorophyll content in mango cv. SufaidChaunsa.Int. J. Biosci., 13, 91-99.
3. Ahmad, N., Nadeem, M.K, Ali, M. A, Kiran, S. and Danish, S. (2019). Screening of salt tolerant transgenic and non-transgenic cotton varieties under various levels of NaCl induced salinity stress. Int. J. Biosci., 14, 100-110.

4. Mlik, M.T., S.A.H., Naqvi, M.A. Bakhsh and T.Tariq, 2019. Field case investigation of Mango malformation disease in five Districts of Southern Punjab and its Biological medicated management under controlled conditions.P.J.Phytopathol.,31(02).p.191-197

Abstracts submitted

1. **"**Efficacy of different Insecticides for the control of Mango Thrips Scirtothripsdorsalis Hood. (Thripidae: Thysanoptera) at Nursery level'' has been submitted in 40th Pakistan Congress of Zoology 2020

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