

ANNUAL ABRIDGED REPORT

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INTRODUCTION:

It is a well-established fact that horticulture industry can contribute enormously in economy of Pakistan. A substantial amount of fruit including mango is being exported to USA, European countries and Middle East. Mango flourishes in both tropical and subtropical climate of the world. In Pakistan, it is being grown in provinces of Punjab and Sindh. Pakistan occupies 170.1 thousand hectares under mango crop with production of 1728 thousand tons. The Punjab province contains 112.4 thousand-hectares area under mango that generates 1325 thousand tones production with share 76.68% in production of the country. In Punjab, it is mainly grown in Multan, the hub of mangoes, followed by Rahim Yar Khan and Khanewal. The importance of mango can be gauged from the fact that Mango Research Institute has been established in 2012 in Multan to boost mango production in Punjab by conducting holistic research pertaining solely to mango and creating awareness amongst farmers' community. Moreover, the approach of government has been diverted towards farmers' oriented approach, thereby, farmer community has been empowered by development of relevant research and development boards, chaired by people elected amongst the growers by themselves. Similarly, to cope with mango related problems, Mango Research and Development Board (MRDB) has started its working since May, 2017. Hence, the research program was devised keeping in view problems being faced by the mango community. The salient achievements during the year 2016-17 are mentioned as:

1. HORTICULTURE SECTION

1.1 USE OF INTERSTOCK TECHNIQUE IN MANGO TO EVALUATE ITS IMPACT ON PLANT DWARFNESS AND FRUIT MATURITY IN MANGO CV. SINDHRI

This research trial was executed with emphasis to invigorate the dwarfness character into a local vigorous growing mango cultivar Sindhri. A mango polyembryonic variety 13-1 originated in Israel was used as rootstock and it possess good tolerance toward the calcareous based soil. The experiment consisted of four treatment T1 (13-1 rootstock interstocked with Sensation and final stock with Sindhri), T2 (13-1 rootstock interstocked with Neelum and final stock with Sindhri), T3 (13-1 rootstock interstocked with

Tota Pari and final stock with Sindhri) and T4 (13-1 rootstock interstocked and final stock with Sindhri) repeated four times under RCBD design. Our local acclimatized dwarf mango cultivars like Sensation, Neelum, Tota Pari and vigorous growing cultivars Sindhri were used as interstocks. When these interstocks attained the graftable height of 30cm, the scion of Sindhri was grafted on these interstocks accordingly. The said plants were transferred to bigger pots for further growth in October, 2016. These plants have been transplanted in the field for required studies in October, 2017 The results showed that maximum plant height (98.50cm) and number of flushes per plants (07) were recorded in T4 whereas minimum plant height (84.50cm) and number of

flushes per plants (05) were recorded in T1 (Sensation). The dwarfness character was manifested well in case of Sensation and second most was in Neelum yet.

1.2 DEVELOPMENT OF NEW MANGO VARIETIES THROUGH HYBRIDIZATION

This research experiment was planned to develop new mango varieties with better yield and quality traits through hybridization of promising mango cultivars. It comprised of three crosses T1 (Sufaid Chaunsa x Sindhri), T2 (Sindhri x S.B. Chaunsa), T3 (SB Chaunsa x Sensation) and reciprocated as well. These mango cultivars emerged sparse flowering in January due to warm weather conditions. The flowers of these combinations were crossed and approximately 300 crosses of each combination were made. The fruit set percentage was satisfactory and afterwards strong wind storm causes fruit drop. Only cross of (Sensation x S.B. Chaunsa) was succeeded with two hybrid fruits paving towards its maturity. The cross of (Sindhri x Sammar Bahisht Chaunsa) matured 02 hybrid mango fruits and 01 hybrid fruit was matured both in (Sammar Bahisht Chaunsa x Sindhri) and (Sufaid Chaunsa x Sindhri). The stones of hybrid mango fruits were planted for germination purpose and the seedling were placed in nursery lath house conditions under intensive care for further proliferation. 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 Sammar Bahisht Chaunsa x Sindhri attained the plant height of 172cm while Sindhri x Sufaid Chaunsa possess 131cm and Sensation x Sammar Bahisht Chaunsa has 107cm 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.

1.3 RESPONSE OF VARIOUS MANGO CVS. THROUGH STONE GRAFTING

This experiment was carried out to explore the effect of grafting practice on mango nursery plants nourishing on their stones with enunciation to prepare grafted plants in a short period of time. Initially mango seedlings of Sindhri, Chaunsa (SB), Dusehri, Anwer Retaul, Chaunsa (Sufaid) and Retaul No. 12 were used as rootstock and stone grafting was practiced after attaining the age of 5, 10, 15, 20 and 25 days respectively. Consequent upon the previous research endeavors the sphere of treatments was curtailed

on their performance. The Sindhri, Sammar Bahisht Chaunsa and Sufaid Chaunsa were concluded as good rootstock due to their high germination and vigorous seedling growth but in case of grafting practice the seedling age of 10, 15 and 20 days gave glaring success. Sindhri rootstock expressed 66% success of stone grafting while Sammar Bahisht Chaunsa and Sufaid Chaunsa gave 70% and 68% success respectively, after attaining the age of 15 days of rootstock.

1.4 PERFORMANCE OF MANGO CULTIVAR SAMMAR BAHISHT CHAUNSA ON VARIOUS POLYEMBRYONIC MANGO ROOTSTOCKS

This trial was conducted to evaluate the response of mango cultivar Chaunsa (Sammar Bahisht) 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 Chaunsa (Sammar Bahisht) 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 (105 cm) was recorded in T2 where Kensington Pride was used as rootstock and in T4 Bullocks Heart gave (78cm) but in case of T3 R2E2 the plant height was minimal (70cm). Number of vegetative flushes per plant in T3 was recorded (08) whereas six flushes were observed in T4. The bud wood screening experiment concluded Carabao Lamao and Bullock Hearts manifested tolerant against mango sudden death disease after inoculation with (*Ceratocystis fimbriata*). 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 Sammar Bahisht Chaunsa would be grafted accordingly for further study.

1.5 SURVEY FOR THE SELECTION OF NEW PROMISING MANGO VARIETIES

The experiment was long term nature to identify the chance seedling mango tree having better traits. Intensive survey was carried out to the whole mango region and fruits of promising varieties were collected and evaluated for quality attributes. The varieties showed significant behavior were remained under close observation

of the researchers to explore its characters and the bud sticks were also collected and multiplied in the sectional mango nursery for further evaluation. Newly identified mango selections are given as under:

Selection Identified	Fruit weight (g)	Peel weight (g)	Stone weight (g)	Pulp weight/ Fruit (g)	TSS (%)
PREVIOUS SELECTIONS					
Azeemu	320	55	73	192	24.5
Aminwala	334	40	31	263	21.0
Armaghan	339	57	22	260	17.7
Ahmadnawaz	298	62	22	214	23.3
Azharwala	274	30	32	212	22.5
Zeeshan	240	35	40	165	28.0
Balliwala	282	33	35	214	17.0
Pardesi	415	35	42	338	22.4
Neelum Anokh	175	35	40	100	23.4
Pasand Anokh	450	75	33	342	24.7
Langra Late	393	42	52	299	23.5
NEW SELECTIONS					
Sajjan	320	55	73	192	24.5
FK-2017	470	65	84	321	22.3

1.6 EFFECT OF PLANTING GEOMETRY ON YIELD AND QUALITY OF SINDHRI

The experiment was aimed to determine the appropriate planting density for high yield and better fruit quality of mango Cv. Sindhri under climatic conditions of Multan. The experiment comprised of four treatments as T1 (25 x 20), T2 (30 x 25), T3 (35 x 30) and T4 (40 x 40) covered on an area of half acre under each treatment according to RCBD. The plant height of 120cm, 107cm, 105cm and 102cm was recorded in T1, T2, T3 and T4, respectively. Number of flushes per plant was 12, 10, 11 and 10 observed in T1, T2, T3 and T4 plants. The overall health was good and plants were flourishing well in the field conditions.

1.7 SOME ADVANCES TO COMBAT THE ALTERNATE BEARING DISORDER IN MANGO CV. SB CHAUNSA.

The experiment was devised to rectify irregular bearing habit in mango Cv. SB Chaunsa through management practices. These management practices include split doses of N, P, K, (T1) potassium nitrate (T2), harvesting of fruit at TAPKA stage (T3) and irrigation stoppage for on-year plants in October (T4). Uniform plants of Cv. SB Chaunsa were selected and tagged. All the standard practices were applied except in case of treatments. Data were recorded and interpreted to reveal the results. T2 exhibited the maximum number of flowering terminal percentage (82%), fruiting terminal (70%) and yield (210 kg). Whereas, minimum number of flowering terminal

(60%), fruiting terminal (45%) and yield (120kg) was recorded in T1.

Results	Treatment	Flowering Terminal %	Fruiting Terminal%	Yield/Plant (kg)
	To	60	45	120
	T1	75	64	180
	T2	82	70	210
	T3	73	60	160
	T4	70	56	155

1.8 EFFECT OF DIFFERENT CHEMICAL TO PROTECT MANGO SEEDLINGS FROM FROST AND COLD WEATHER INJURIES

The experiment was designed to determine the effective treatment against the prevailing frost/cold weather injuries for mango seedlings. Six foliar sprays of mentioned chemicals were applied after 15 days' interval starting from 15th November to 15th February. These include control (T1), H₂O₂ (T2), Ascorbic Acid (T3), Salicylic Acid (T4), and three commercial products Wet Cit (T5), Megafal (T6) and AF-6 (T7). Data for the frosty night and its intensity was recorded from monthly meteorological data. The performance of T7 was best among among all treatments as minimum number of damaged buds (01), damaged leaf (03) and no symptoms of bark splitting were observed.

2. PLANT PATHOLOGY SECTION

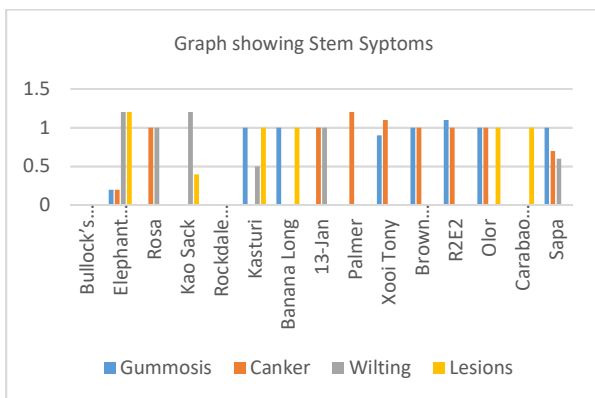
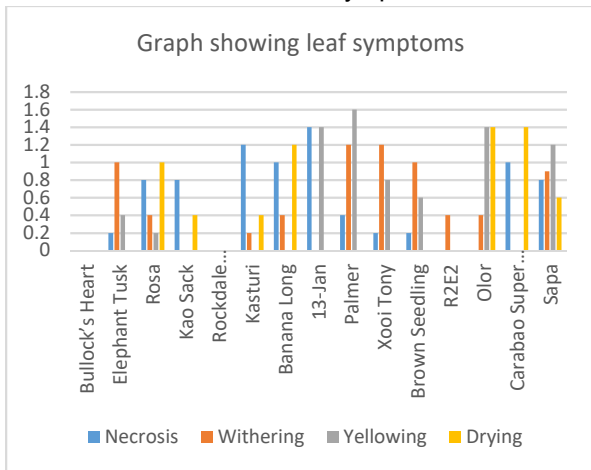
2.1. *IN-VIVO* SCREENING OF AVAILABLE EXOTIC GERMLASM OF MANGO AGAINST (MANGO QUICK WILT DISEASE) MQWD.

This study was executed to find out resistant/tolerant root stock against Mango Sudden Death Disease (MQWD) through making inoculations with virulent strain of (*Ceratocystis manginecans* and *Lasiodiplodia theobroamae*) according to standardized protocols in lath house of Mango Research Institute, Multan. Seedling mango of 01-year age raised in standardized pot media were grafted with the scion woods through wedge grafting technique of the following polyembryonic varieties:

Sr. No.	Polyembryonic variety Name
1.	Bullock's Heart
2.	Elephant Tusk
3.	Rosa
4.	Kao Sack

5.	Rockdale Siagone
6.	Kasturi
7.	Banana Long
8.	13-1
9.	Palmer
10.	Xooi Tony
11.	Brown Seedling
12.	R2E2
13.	Olor
14.	Carabao Super Manila
15.	Sapa

The symptom expressions on each variety were recorded almost after 01 month of inoculation. The signs on leaves viz. necrosis, yellowing, drying and withering were recorded with (0 to 3) rating scale. On stem, the symptoms viz. gummosis, cankers, wilting and lesions were examined with the same rating scale. The result revealed that Bullock's Heart and Rockdale Siagone showed no symptom expressions on leaves as well as on stem. However other varieties R2E2 and Carabao Super Manila showed minimum extent of symptoms.



2.2 ISOLATIONS, IDENTIFICATIONS AND PRESERVATION OF THE ASSOCIATED FUNGI WITH MANGO PLANTS TO MAINTAIN CULTURE BANK.

The experiment was conducted to maintain cultures of different known and new pathogens for further studies from mango orchards. During the survey of the mango orchards, diseased samples from symptomatic plants were collected and analyzed in the laboratory according to the standardized protocols. The pathogenicity test of newly identified microorganism was also conducted for confirmation of capability to cause the disease. Unusual symptoms provided by the mango growers were also entertained. The following cultures of the pathogenic fungi associated with mango were obtained and preserved at 4°C in incubator:

Culture	Status
<i>Fusarium mangiferae</i>	Isolated from malformed panicles, leaves and healthy flowers.
<i>Colletotrichum gloeosporioides</i>	Isolated from leaves and fruits showing anthracnose symptoms as it is an established pathogen of mango. Recently isolated from mango hopper and Blow fly .
<i>Ceratocystis manginecans</i>	Isolated from wilted mango plants, nursery potting mixes and panicles as it has been recently declared as cause of MQWD
<i>Natgrassia mangiferae</i>	Isolated from leaves showing Chlorosis/ leathery symptoms and potting mixes. Its Pathogenicity on leaves is still under progress as its mode of spread on leaves is new on mango.
<i>Pseudomonas syringae</i>	This bacterium was isolated from emerging buds showing necrosis and its Pathogenicity is still to be done but this bacterium is already reported
<i>Alternaria alternata</i>	Isolated from mango mealy bug and mango hopper.

2.3. PROACTIVE MANAGEMENT OF MANGO MALFORMATION DISEASE (MMD) THROUGH DISEASE ESCAPE OPTION.

The study was conducted to minimize the infection of Mango Malformation Disease through application of Naphthalene acetic acid (NAA) in combination with Score (Difenoconazole) and Cabriotop. Tagging of 30 mature terminal shoots on each experiment plant was done. 1st spray of NAA and fungicides was done during 1st week of October. 2nd spray during second week of October. Pathogenic fungi were detected from 10 tagged shoots. The following treatments were applied during the study. The maximum reduction by 93% in colonies development of *Fusarium mangiferae* in petri dishes was recorded in which samples taken from the experimental plants of T7, were exercised followed by T8 with the decrease in colonies by 83%. The same treatments remained at par in minimizing the disease for the next year by 87.5%. It means that two sprays of NAA @400ppm along with Difenoconazole or Cabriotop at their recommended doses may be done during the month of October to combat the problem of MMD.

2.4. DEVELOPING PROTOCOLS FOR CLEAN POT MEDIA TO ESTABLISH CONTAINERIZED MANGO NURSERY.

The experiment was done to observe the infection frequency of soil borne pathogens in potting mix and to standardize the method of its sterilization/ pasteurization to make free from contamination. The experiment was done by using six treatments with three replications and CRD. The following treatments were used. Application of all the treatments was done to the potting mix already in use and artificially contaminated potting mix. The potting mix was

T1	Steaming with pressure (82°C at 10lb for 30 minutes)
T2	Steaming without pressure(30 minutes)
T3	Heating in oven(82°C for 30minutes)
T4	Solarization (65°C for 6-8 weeks)
T5	Sterilization with formalin(20ml/l)
T6	Sterilization with hydrogen peroxide (30ml/l)
T7	Control

contaminated with one petri dish dissolved in 500 ml of water. Determination of soil contaminants

before and after treatments through agar slant technique was done.

The results revealed that potting mix already in use and artificially contaminated potting mix sterilized/ pasteurized with stem at 82°C through developing pressure of 10lb for 30 minutes had 0% infestation. No soil contaminant was observed. while other treatments remained almost ineffective with the isolation of *Ceratocystis manginecans* and *Nattrassia mangiferae* with maximum set of values by 93.33 and 85.66 in pattern in rest of treatments.

3. ENTOMOLOGY SECTION

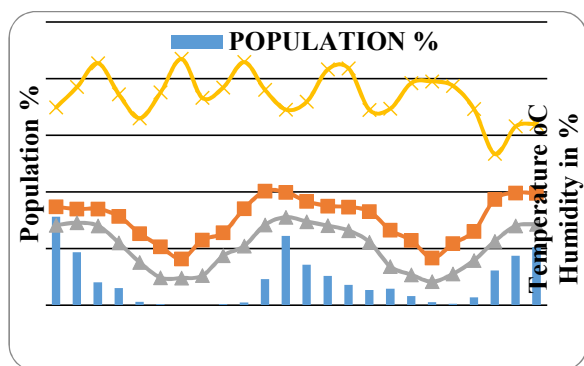
3.1 POPULATION DYNAMICS OF FRUIT FLY

T1	200ppm NAA + Difenoconazole (One spray)
T2	200ppm NAA + Cabriotop (One spray)
T3	400ppm NAA + Difenoconazole (One spray)
T4	400ppm NAA + Cabriotop (One spray)
T5	200ppm NAA + Difenoconazole (Two sprays)
T6	200ppm NAA + Cabriotop (Two sprays)
T7	400ppm NAA + Difenoconazole (Two sprays)
T8	400ppm NAA + Cabriotop (Two sprays)
T9	Control

(DIPTERA: THYPHRITIDAE) SPECIES ASSOCIATED WITH DIFFERENT FRUITS INCLUDING MANGO

Surveillance of mango fruit fly population was undertaken by installing six traps at the height of 2m from the ground surface with the help of nylon thread and at a distance of 60m apart in Experimental Mango Orchard, Mango Research Institute, Multan. Grease was applied to the 1/3 proximal part of thread near the branch to prevent ants from preying on Fruit Flies. Attractant used for monitoring was methyl eugenol along with Trichlorfon as killing agent in 10:1. Traps were emptied weekly and insect collection was shifted to the Plant Protection Lab of Mango Research Institute Multan for their counting and identification. The identification was made on the basis of their morphological characters by using taxonomic key. It was observed that cumulative population of both species named *Bactrocera zonata* and *Bactrocera dorsalis* was 31.22% followed by 24.45% of the total population of the whole year (2015-16) during the months of July and June respectively. During 2016-17, maximum population of this pest was recorded by

20.46% during the month of June followed by the population noted during May by 17.42%. The thermal regime and RH during maximum infestation for the year 2015-16 fluctuated from 28.29°C to 34.75°C and 69.84% RH respectively while it ranged from 28.63°C to 39.50°C with RH of 63.98% during June 2016-17. High temperature and low RH during June 2016-17 resulted in early ripening of the mid seasonal varieties like S.B Chaunsa which is also supposed to be more susceptible to this obnoxious pest. Consequently, high population of Fruit Fly was recorded during June 2016-17. It means that availability of susceptible mangoes has also paramount importance along with the metrological parameters for high infestation of Fruit Fly. Population dynamics of mango fruit fly is given below:



Population dynamics of fruit fly in mango during the year 2015-17

3.2 EXPLOITATION OF QUANTITATIVE STUDIES PERTAINING TO MANGO FRUIT FLY

This study was conducted through adopting the standard method using Methyl Eugenol 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 19.2 followed by 10.41 and 8.60 percent in cultivars Chaunsa (SB) and Sufaid Chaunsa respectively. Two species

named *Bactrocera zonata* and *Bactrocera dorsalis* were predominantly prevalent in experimental orchard by 93.03 and 6.97 percent respectively with sex ratio of 3:1 for both species totally in contrast to the previous findings. The new inquiry in hand will be useful to stream line the management strategy against this challenging insect pest in Pakistan.

INSTALLATION OF SEX PHEROMONE TRAPS AVERAGE POPULATION OF FRUIT FLY PER TRAP (in one week)

Variety	<i>B. zonata</i>			<i>B. dorsalis</i>			Other species		
	M	F	Total	M	F	Total	M	F	Total
Sindhri	82.79	0	82.79	6.21	0	6.21	0	0	0
Chaunsa S.B	121.5	0	121.5	7.5	0	7.5	0	0	0
Chaunsa Sufaid	136.1	0	136.1	10.9	0	10.9	0	0	0

POPULATION %AGE OF VARIOUS SPECIES OF FRUIT FLY ON DIFFERENT VARIETIES

Variety	No. Flies per trap	<i>B. zonata</i>	<i>B. dorsalis</i>
Sindhri	89	93.02 %	6.98 %
Chaunsa (S.B)	129	94.18%	5.81%
Chaunsa Sufaid	147	92.58%	7.42%
Total	365	93.25	6.75%

ON-TREE INSPECTION

Variety	No. of inspected fruits	No. of suspected fruits	No. of fruits cut	Fruits attacked		%age attack
				Yes	No	

Sindhri	300	26	26	5	19	19.2%
Chaunsa (SB)	400	48	48	5	43	10.41%
Chaunsa Sufaid	400	35	35	3	32	8.6%

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	40	40	40	18	22	45.00%
Chaunsa (SB)	57	57	57	40	17	70.17%
Chaunsa Sufaid	52	52	52	36	16	69.23%

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	145	05	28	33	04	05	09
Chaunsa (SB)	405	66	202	268	03	07	10
Chaunsa Sufaid	280	39	74	113	05	07	12
Total	830	110	304	414	12	19	31

(1) Adult emergence from Pupae after rearing in Laboratory:

$$445/830 \times 100 = 53.61\%$$

(2) Sex Ratio

Female : Male
 323/445 X100 : 122/445 X 100
 72.58% : 27.42%
 3 : 1

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

B. zonata : **B. dorsalis**
 414/445 x 100 : 31/445 x 100
 93.03% : 6.97%

3.3 IDENTIFICATION OF THE NEW COMPLEX EMERGING INSECT PESTS IN MANGO ORCHARDS AND THEIR CHEMICAL MANAGEMENT

This experiment was conducted to identify new insect pests viz. Fruit borer, leaf webber and leaf miner which are very much confusing and to find out their effective chemical control. For this purpose, collection of the infested samples, rearing of various stages of insect pests in laboratory and identification of the pest on the basis of morphological characters was done as the integral part of the study. The rearing of different types of larvae collected from infested fruits and leaves in the lab resulted in successful development of adults through passing various phases of their life cycles. The newly emerged adults were identified on the basis of their morphological characters by using of identification material available on the net. Preliminary, it was found as fruit borer (*Citripestis eutrapphera* Pyralidae: Lepidoptera). Similarly the black spotted yellow shoot and fruit borer (*Conogethes spp.* Crambidae: Lepidoptera) was identified.

4. POST-HARVEST SECTION

4.1 STANDARDIZATION OF MATURITY INDICES OF PROMISING MANGO VARIETIES

The research trial was conducted to search out the appropriate time of harvesting of promising mango varieties. The treatments T₁ (Aalishan), T₂ (Late Sindhri) and T₄ (Azeemu) were harvested at four different maturity stages: T₁ at 80, 90, 100 & 110 days, T₂ at 100, 110, 120 & 130 days and T₄ at 120, 130, 140 & 150 days from fruit set, replicated thrice under CRD factorial design. The quality attributes were evaluated in Post-harvest Laboratory of this Institute. The harvesting of Aalishan, Late Sindhri, and Azeemu at the maturity stage: 90, 120 and 140 days respectively was observed relatively better in color development, TSS (22.9, 17.7 and 22.8%),

acidity (0.21, 0.18 and 0.21%) shelf life (8, 7 and 9 respectively). At this harvesting stage: T₁ exhibited 9.5% TSS and 8.6 kg firmness, T₂ revealed 7.4% TSS and 9.5 kg firmness while in case of T₃, 8.3 % TSS and 9.6 kg firmness accordingly.

4.2 DETERMINATION OF POST-HARVEST LOSSES IN MANGO SUPPLY CHAIN

The research trial was conducted to measure post-harvest losses of mango at different stages from harvesting to its marketing. One lot of mangoes consisting seven crates was purchased from local wholesale market harvested from local orchard around Multan to assess the quantitative losses. Two other consignments containing 18 crates were also evaluated for different traditional and improved methods of harvesting and packing and then were transported to different markets for losses losses. First consignment consisting Black Chaunsa mango was harvested from Vehari and transported to Kalabagh (450 km away) whereas second consignment consisting of Sufaid Chaunsa fruit was harvested from Multan and transported to DG Khan (150 km away). The quantitative losses in improved harvesting and improved packing were negligible whereas these were recorded as 1-2% during harvesting and 8-12% during ripening and transporting in traditional method. Qualitative losses were observed as 23% during harvesting and 9% in belly packing in traditional method as compared with improved one. On an average post-harvest losses were 10% quantitative and 32% qualitative in traditional harvesting and packing techniques.

5. PLANT NUTRITION SECTION

5.1 Effect of pre flowering and pre harvest foliar spraying of some macro and micro nutrients on mango cv. Chaunsa SB

The study was initiated to compare the effect of foliar applied Calcium Nitrite, Potassium Nitrate and Potassium Citrate alone and in combination with Boric Acid on fruit retention, ripening, shelf-life and yield of mango Cv. Chaunsa SB. Generally it is believed that K and Ca sources play a significant role in enhancing fruit setting, retention, reducing SER, and increasing shelf life of mango fruit and Nitrogen use efficiency respectively. Therefore, to achieve the above mentioned targets, treatment combinations were set as: Control (T₁), Foliar application of Boric Acid 0.2% (T₂), Foliar application of Ca(NO₃)₂1.0% + Boric Acid 0.2% (T₃), Foliar

application of CaCl₂1.0% + Boric Acid 0.2% (T₄), Foliar application of K-Citrate1.0% + Boric Acid 0.2% (T₅), Foliar application of K₂SO₄ 1.0% + Boric Acid 0.2% (T₆), Foliar application of KNO₃ 1.0% + Boric Acid 0.2% (T₇). The treatments were applied at pre flowering (during the month of March) and pre harvest stage of fruit with the help of tractor mounted Jecto Sprayer. The results indicated that No. of fruit set (38fruit/panicle), average fruit weight (270g), retention (0.56%) and yield (148kg/plant) were found significantly high in treatment where KNO₃ 1.0% + Boric Acid 0.2% were applied as compared to control and other treatments. Shelf Life (14 days) and TSS (24.9Brix°) were found significantly high in treatment where K₂SO₄ 1.0% + Boric Acid were applied. Significantly lowest SER (26.75%) was reported in treatment KNO₃ 1.0% + Boric Acid 0.2% with highest level of Boron (26.88ppm) in mango leaves.

5.2 Effect of pre-harvest spray of antioxidants along with micronutrients on post-harvest shelf life and quality of mango cv. Chaunsa Sufaid

A study was carried out to evaluate the effect of some antioxidants (Ascorbic acid and Citric acid) alone and in combination with micronutrients mixture (Zn, Cu, Fe and Mn) as foliar application on fruit retention, yield and fruit quality of mango Cv. Chaunsa Sufaid. Treatment combinations applied were: Control(T₁), Foliar application of Citric Acid @1000ppm(T₂), Foliar application of Ascorbic Acid @1000ppm(T₃), Foliar application of Citric Acid @1000ppm + (Zn, Cu ,Fe and Mn) @0.15%(T₄), Foliar application of Citric Acid @1000ppm + (Zn, Cu ,Fe and Mn) @ 0.30%(T₅), Foliar application of Ascorbic Acid @1000ppm + (Zn, Cu, Fe and Mn) @ 0.15%(T₆), Foliar application of Ascorbic Acid @1000ppm + (Zn, Cu, Fe and Mn) @ 0.30%(T₇). The results revealed that the foliar application of Citric Acid @1000ppm + (Zn, Cu, Fe and Mn) @ 0.30% was favorable in improving quality parameters of fruit with maximum results obtained regarding TSS (28.0Brix°), shelf Life (14 days), SER (22%) and fruit set/panicle (46), fruit retention (0.51%), fruit weight (387g) and yield of mangoes (124kg/plant) followed by foliar application of Citric Acid

@1000ppm + (Zn, Cu, Fe and Mn) @ 0.15% (24.5Brix^o) and minimal acidity from (0.27% to 0.22%) respectively. Moreover, significantly higher N (0.93%), P (0.18%), K (0.50%) and Micronutrient concentration Zn (38ppm), Cu (7.03ppm), Fe (157ppm) and Mn (48ppm) were reported with the application of Citric Acid @1000ppm + (Zn, Cu, Fe and Mn) @ 0.30%.

Fig. Tagging of experimental trees, sample digestion for N estimation sample preparation for P determination

5.3 Responses of boron application times on mango fruit setting, retention and fruit quality in mango cv. chaunsa Sufaid

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 Sufaid. The treatment plan was as following: Control (T₁), Foliar spray of Boric Acid 0.08 % before bud initiation (T₂), Foliar spray of Boric Acid 0.08 % before fruit setting (T₃), Foliar spray of Boric Acid 0.08 % pre harvest of fruit (T₄), Soil application of Boric Acid 60g/plant before bud initiation (T₅), Soil application of Boric Acid 60g/plant before fruit setting (T₆) and Soil application of Boric Acid 60g/plant pre harvest of fruit (T₇). Before application of treatments basic analysis of soil samples was conducted. Loam textured soil was free from salinity and sodicity (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 (46), fruit retention % (0.54), fruit weight (337g), 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 for

these all above mention parameters. Moreover, highest value of TSS (25.5Brix^o) and shelf life (15 days) was found in the same treatment where Boric Acid 60g/plant before bud initiation was applied.

Fig. Addition of B leaf extract, Azomethine-H in propylene tubes and reading on spectrophotometer at 420nm wavelength

5.4 Standardization of nutritional requirements of die back affected plants in Chaunsa SB with integrated approach

A new 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 (T₁), RD of NPK + FYM (T₂), recommended dose of NPK + City Waste (T₃), recommended dose of NPK + Poultry Manure (T₄), recommended dose of NPK + Press Mud (T₅), recommended dose of NPK + Sulfur (T₆). 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 2.95 dSm⁻¹ and pH 8.55) with slightly deficient P (7.62ppm), K (160ppm) and low in organic matter (0.69%). Before application of treatments leaves were analyzed for NP and K. low level of N and P

concentration was observed. After application of treatments, significantly lowest disease intensity (0.13%) was recorded where recommended dose of NPK + Poultry Manure (T₄) was applied, followed by recommended dose of NPK + Sulfur (0.16%).

OTHER DEVELOPMENT ACTIVITIES

Radio Talks	15
TV Talks	05
Capacity Building Program	25
Seminar	10
Urdu/English Articles	15
Farmer Gathering	06
VIP meetings	05
Mango Festival	02
Class Visited	08
Internee/M.Sc.	06
Special Meetings	05
Grower Visited	70
Orchard Visited	30

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ANNUAL ABRIDGED REPORT OF HORTICULTURIST, MANGO RESEARCH STATION, SHUJABAD FOR 2016-17

INTRODUCTION

Mango is a delicious fruit grown in almost all the tropical and subtropical countries of the world and is the second largest fruit crop of Pakistan after citrus and is being grown on 174 thousand hectares with annual production of 1716 thousand tons of fruit (Pak. Agri. Statistics 2014-15). The mango is mainly grown in the Province of Punjab and Sindh. The climate of Sindh is almost one month early than Punjab.

Mango Research Station, Shujabad was established in 1972-73 by the Government of Punjab to overcome the basic problems of mango crop.

Pakistan falls in top six mango producing countries but export of fresh mango fruits to different countries is less than 10 percent of total produce. The export needs to be extended upto 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% low quality produce. The weakness in basic infrastructure, 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. Different NGO's and supporting agencies USAID, UNIDO and ASLP have done much in mango sector in collaboration with local departments to support the local mango industry. Hopefully these coordinated efforts will change the whole scenario of export in coming few years and mango industry of Pakistan will flourish in the world in near future.

1.Survey for selection of promising mango strains

In the fruit plants, three conventional 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 scattered available material.

During survey and selection of promising mango strains, one mid-season variety "Late Sindhri" was identified three years before in Jalalpur and one late season variety Azeem Chaunsa was also identified from Uch Sharif in the same years and behaviour of

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

Late Sindhri: The fruit size is large i.e. 400-750 gm, flesh firm with deep yellow and shining colour. The skin is shining and attractive mature in mid-July and can be kept on 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.

Azeem Chaunsa: is another variety which is late in season with medium size and have firm flesh. The tree is heavy bearer and fruit has extended shelf life. It matures during last week of August with average yield of 550 kg per plant.

Both varieties have good on tree storage ability, compact flesh and extended shelf life and these are spreading rapidly among growers and their major production is being exported. These varieties have been planted at this research station for further study and characterization of both varieties have been completed this year and DUS tested will be initiated in next flowering season.

2.Evaluation of polyembryonic root stock for commercial mango cultivar of Punjab

The bud woods of 46 Polyembryonic mango varieties were imported during March 2009-10 and out of these 27 varieties are growing successfully.

From the data regarding health and vigour of the plants (height, spread and stem girth), out of 26 cultivars 06 varieties are vigorous and 05 are dwarf in nature while remaining 16 showed medium or weak growth.

20 varieties produced fruit this year and most of these varieties have been found polyembryonic.

150 plants of one Polyembryonic variety 13-1 have been prepared in pots and will be shifted in nursery in spring 2018.

The commercial varieties will be grafted on these root stock for further evaluation against soil salinity, drought and bearing behaviour. It is added that this variety has strongly Polyembryonic behaviour, (3-5

plants from a stone) and a well-known rootstock against salinity.

3.Impact of time of fruit harvesting on next year fruiting in mango cv. SB Chaunsa

This experiment was initiated with the objective to find out the proper time of harvesting of mango to get regular fruiting every year because it is a common practice that harvesting is mostly delayed due to fall in market prices. The delayed harvesting result in poor or no post-harvest vegetative growth. Resultantly, proper bud differentiation could not take place and plants remain unproductive for next year. So, it is important to explore the real impact of harvesting time on next year fruiting, this experiment has been designed.

- T1: Harvesting of all mango fruit at initial tapka stage.
- T2: Harvesting of mango fruit after 7 days of tapka stage.
- T3: Harvesting of mango fruit after 14 days of tapka stage.
- T4: Harvesting of mango fruit after 21 days of tapka stage.
- T5: Harvesting of all mango fruit at tapka stage only (Control).

The results depict that under T1 maximum flushes (71%) after fruit harvest (2016) were produced followed by flowering (63%) & yield (80kg) under same treatment. However, the same parameters remained minimum under T₅ (control). So, it can be concluded that timely fruit harvesting keeps the plants under regular fruiting. However, during current year maximum fruit was dropped/ damaged due to wind storm received on 10.06.2017.

4.efficacy of different bagging material for the control of mango fruit fly in Cv. Sufaid Chaunsa

This experiment was initiated with the objective to provide a physical barrier on the fruit to protect it against the mango fruit fly and improve the fruit quality. The mango fruit fly is the quarantine pest and creates hindrance in export and cause heavy fruit and

trade loss. This pest is controlled by different means like sanitation, male annihilation techniques (MAT) and bait application techniques (BAT), but in some countries this insect also being controlled by wrapping of individual fruit with bags. With this practice mango fruits on tree remained safe from fruit fly and other physical injuries and bruising. So, this experiment is being conducted to evaluate different bagging materials in cv. Sindhri and Chaunsa Sufaid.

Different bagging materials i.e. Common Newspaper, Chinese Newspaper, Brown paper and Sufaid paper were tested to achieve the above mentioned goal. During last year 2016, three varieties i.e. Sindhri, Chaunsa SB and Chaunsa Sufaid were selected to conduct this experiment and at the end it was concluded that this method of wrapping individual fruit is not suitable for Sindhri and Chaunsa SB varieties as both varieties ripe abruptly and due to wrapping it is not possible to harvest the fruit as it is invisible in the bags and at time of harvesting many of these get wasted.

Therefore, during this year only one variety i.e. Chaunsa Sufaid was tested which have comparatively good on tree storage ability and Sindhri was wrapped by grower himself. The current year data shows that minimum bag damage was recorded in brown paper bags i.e. 46% due to wind storm / rain while maximum damaged bags i.e. 60% was recorded under T₃(Chinies news paper bags) followed by 54% damage under T₅ (Sufaid paper bags) it is pointed out that maximum damage of bags was caused by the sever wind storm received on 10.06.2017.

5.Effect of number of leaves on rootstock (below graft union) on the success grafting (cleft) in mango.

This experiment was initiated with the objective to find out the minimum requirements of leaves for grafting on rootstock to make the grafting successful on 6 to 9 months old potted mango seedlings and to explore the roll of leaves on success of grafting. The plants were selected and maintained a month before grafting by keeping desired number of leaves on rootstock. These plants were grafted by cleft technique during March 2017 when they enter into active growth stage.

The seedlings were grafted according to the treatments i.e. 0,1,2,3,4,5,6 leaves below the graft union. The success % was found maximum with 4 or more leaves i.e. 76- 80% and minimum success was recorded with 0 leaves i.e. 14%. As far as the height of the plant is concerned it was found maximum 81.14 cm in 4 leaves while minimum 39.85cm under 0 leaves. From these results it may be concluded that 4 or more healthy leaves are required below the graft union for better success and excellent plant growth.



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