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INTRODUCTION:

The mango, fruit of all ages, is a potential exportable commodity as well as national fruit of Pakistan. Its cultivation occupies area 170.74 thousand hectares with annual production of 1758.00 thousand tons and the Punjab province has 105.65 thousand hectares' area under mango cultivation that generates 1375 thousand tons production during 2016-17. Modern era has conceptualized the fact that mango industry can only be strengthened by utilizing scare resources with maximum output. Wise use of inputs can only be the source to minimize the cost of production. Further, crop diversification strategy shifts the industry paradigm from conventional cultivation into a vibrant mango industry of Pakistan, by accommodating more number of mango plants into a unit area. However, mechanized approach gear up the laborious canopy management practice into a precise and easy job that curtail the timeline from months into days. The main mango industry drivers are selection of appropriate variety compatible with soil, judicious use of farm inputs, timely harvesting and to ensure profuse vegetative growth that grab the mango crop regularization. Mango Research Institute, Multan committed to serve the farmer community and diversified its strategy to disseminate the knowledge of mango growing at farmer's door step by conducting seminars/workshops in whole mango region. The salient research endeavors were summarized being conducted at this institute during the span of 2017-18.

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 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 Tota Pari 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, 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 T_4 whereas minimum plant height (84.50cm) and number of flushes per plants (05) were recorded in T_1 (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 T_1 (Sufaid Chaunsa x Sindhri), T_2 (Sindhri x S.B. Chaunsa), T_3 (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 01hybrid 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 Late 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 Sammar Bahisht Chaunsa 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 Sammar Bahisht Chaunsa 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 (105cm) was recorded in T_2 where Kensington Pride was used as rootstock and in T_4 Bullocks Heart gave (78cm) but in case of T_3 R2E2 the plant height was minimal (70cm). Number of vegetative flushes per plant in T_3 was recorded (08) whereas six flushes were observed in T_4. 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 in 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 researchers to explore its characters and bud sticks were also collected and multiplied in sectional mango nursery for further evaluation. Newly identified mango selections are given as in Table 1.:

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
NeelumAnokhi	175	35	40	100	23.4
PasandAnokhi	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

Table 1. Data profile of promising mango varieties

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 T_1 (25 x 20), T_2 (30 x 25), T_3 (35 x 30) and T_4 (40 x 40) covered on an area of half acre under each treatment with three replications according to RCBD. The plant height of 120cm, 107cm, 105cm and 102cm was recorded in T_1, T_2, T_3 and T_4, respectively. Number of flushes per plant was 12, 10, 11 and 10 observed in T_1, T_2, T_3 and T_4 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, (T_1) potassium nitrate (T_2), harvesting of fruit at TAPKA stage (T_3) and irrigation stoppage for on-year plants in October (T_4). 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 in table 2. T_2 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 T_1.

Treatment	Flowering Terminal %	Fruiting Terminal%	Yield/Plant (kg)
T_o	60	45	120
T_1	75	64	180
T_2	82	70	210
T_3	73	60	160
T_4	70	56	155

Table 2. Flowering, fruiting and yield of treatments

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 (T_1), H_2O_2 (T_2), Ascorbic Acid (T_3), Salicylic Acid (T_4), and three commercial products Wet-Cit (T_5), Megafol (T_6) and AF-6 (T_7). Data for the frosty night and its intensity was recorded from monthly meteorological data. The performance of T_7 was best 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 germplasm 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 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 one-year age raised in standardized pot media were grafted with the scion woods through wedge grafting technique of 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

Table 3. Polyembryonic mango cultivars used in the study

The symptom expressions on each variety were recorded almost after one 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.

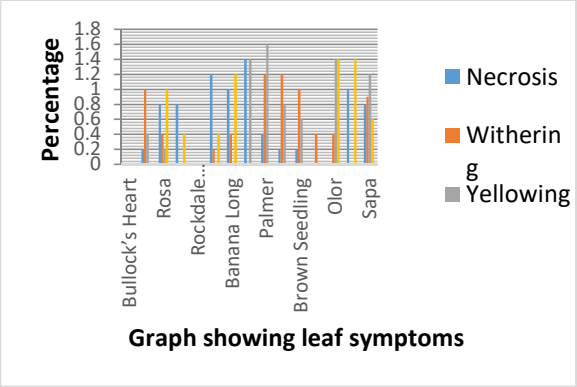

Fig. 1. Results of symptom expression on leaves polyembryonic mango cultivars

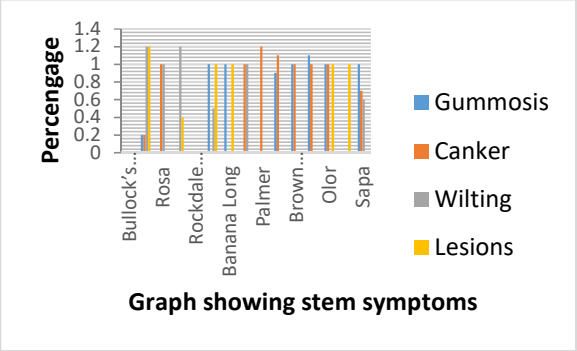

Fig. 2. Results of symptom expression on stem of polyembryonic mango cultivars

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
Fusarium mangiferae	Isolated from malformed panicles, leaves and healthy flowers.
Colletotrichum gloeosporioides	Isolated from leaves and fruits showing anthracnose symptoms as it is an established pathogen of mango. Recently isolated from mango hopper and Blow fly .
Ceratocystis manginecans	Isolated from wilted mango plants, nursery potting mixes and panicles as it has been recently declared as cause of MQWD
Nattrassia mangiferae	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.
Pseudomonas syringae	This bacterium was isolated from emerging buds showing necrosis and its Pathogenicity is still to be done but this bacterium is already reported
Alternaria alternata	Isolated from mango mealy bug and mango hopper.

Table 4. Isolation made from different mango fungi

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

T_1	200 ppm NAA + Difenoconazole (One spray)
T_2	200 ppm NAA + Cabriotop (One spray)
T_3	400 ppm NAA + Difenoconazole (One spray)
T_4	400 ppm NAA + Cabriotop (One spray)
T_5	200 ppm NAA + Difenoconazole (Two sprays)
T_6	200 ppm NAA + Cabriotop (Two sprays)
T_7	400 ppm NAA + Difenoconazole (Two sprays)
T_8	400 ppm NAA + Cabriotop (Two sprays)
T_9	Control

Tabl 5. Treatment combination of different doses of NAA used in study

Fusarium mangiferae in Petri dishes was recorded in which samples taken from the experimental plants of T_7, were exercised followed by T_8 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 treatments used in study are summarized in table. Application of all the treatments was done to the potting mix already in use and artificially contaminated potting mix. The potting mix was contaminated with one petri dish dissolved in 500ml 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℃ 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 mangiferea* with maximum set of values by 93.33 and 85.66 in pattern in rest of treatments.

T_1	Steaming with pressure (82◦C at 10lb for 30 minutes)
T_2	Steaming without pressure(30 minutes)
T_3	Heating in oven(82◦C for 30minutes)
T_4	Solarization (65◦C for 6-8 weeks)
T_5	Sterilization with formalin(20ml/l)
T_6	Sterilization with hydrogen peroxide (30ml/l)
T_7	Control

Table. 6 Treatment combination used for the media sterilization technique

3. ENTOMOLOGY SECTION

3.1 Population dynamics of fruit fly (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 60 m 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 population noted during May by 17.42%. The thermal regime and RH during maximum infestation for the year 2015-16 fluctuated from 28.29ºC to 34.75ºC and 69.84% RH respectively while it ranged from 28.63ºC to 39.50ºC 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 metrological parameters for high infestation of Fruit Fly. Population dynamics of mango fruit fly is given below:

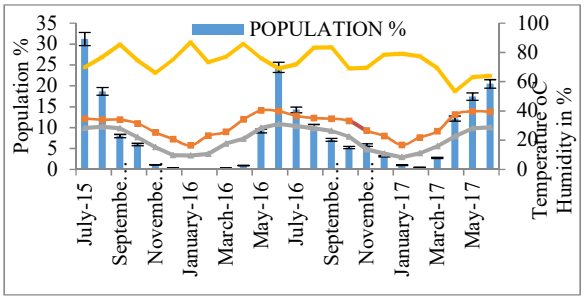

Fig. 3 Population dynamics of fruit fly in mango during the year 2015-17

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

Table 7. Average population of fruit fly per trap (in one week)

Variety	*B. zonata*			*B. dorsalis*			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

Table. 8 Population %age of various species of fuit fly on different varieties

Variety	No. of Flies per trap	*B. zonata*	*B. dorsalis*
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%**

Table 9. On-tree inspection of mango fruits

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

Table 10. Inspection of dropped fruits

Variety	No. of Dropped fruits	No. of suspected fruits	No. of fruits cut	Fruits attacked Yes	Fruits attacked No	%age attack from total dropped fruits
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%

Table 11. 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 X100 = 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 eutraphera* 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 T_1 (Aalishan), T_2 (Late Sindhri) and T_3 (Azeemu) were harvested at four different maturity stages: T_1 at 80, 90, 100 & 110 days, T_2 at 100, 110, 120 & 130 days and T_3 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 observed on 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: T_1 exhibited 9.5% TSS and 8.6 kg firmness, T_2 revealed 7.4% TSS and 9.5 kg firmness while in case of T_3, 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 comprising 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. First consignment consisting Black Chaunsa mango was harvested from Vehari and transported to Kalabagh (450km 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 (the orchard where all recommended code of practices are performed). 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. SB Chaunsa

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. SB Chaunsa. 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 (T_1), Foliar application of Boric Acid 0.2% (T_2), Foliar application of $Ca(NO_3)_2$ 1.0% + Boric Acid 0.2% (T_3), Foliar application of $CaCl_2$ 1.0% + Boric Acid 0.2% (T_4), Foliar application of K-Citrate1.0% + Boric Acid 0.2% (T_5), Foliar application of K_2SO_4 1.0% + Boric Acid 0.2% (T_6), Foliar application of KNO_3 1.0% + Boric Acid 0.2% (T_7). The experiment was laid out RCBD with four repeats. The treatments were applied twice a year, at pre flowering and pre harvest stage of fruit with the help of tractor mounted Jecto-Sprayer. The results indicated that No. of fruit set (47 fruit/panicle), average fruit weight (270g), retention (0.52%) were found significantly high in treatment where K_2NO_3 1.0% + Boric Acid were applied.

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

A study was planned 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. Sufaid Chaunsa. Treatment combinations applied were: Control (T_1), Foliar application of Citric Acid @ 1000ppm (T_2), Foliar application of Ascorbic Acid @ 1000ppm (T_3), Foliar application of Citric Acid @ 1000ppm + (Zn, Cu, Fe and Mn) @ 0.15% (T_4), Foliar application of Citric Acid @ 1000ppm + (Zn, Cu, Fe and Mn) @ 0.30% (T_5), Foliar application of Ascorbic Acid @ 1000ppm + (Zn, Cu, Fe and Mn) @ 0.15% (T_6), Foliar application of Ascorbic Acid @ 1000ppm + (Zn, Cu, Fe and Mn) @ 0.30% (T_7). RCBD with four replications was followed. The results revealed that the foliar application of Citric Acid @ 1000ppm + (Zn, Cu, Fe and Mn) @ 0.30% was found favorable in improving quantitative parameters of fruit with maximum results obtained regarding fruit set/panicle (52), fruit retention (0.53%). Moreover, significantly higher N (0.95%), P (0.15%), K (0.49%) was found with the application of Citric Acid @ 1000ppm + (Zn, Cu, Fe and Mn) @ 0.30%.

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

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. Sufaid Chaunsa. 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). 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 (23.5$Brix^o$) and shelf life (15 days) was found in the same treatment where Boric Acid 60g/plant before bud initiation applied.

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

The study 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. SB Chaunsa 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 their 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 (0.54%). Before application of treatments, leaves samples were analyzed for NP and K. low level of N and P concentration was observed. After application of treatments, significantly lowest disease intensity (0.14%) was recorded where recommended dose of NPK + Poultry Manure (T_4) were applied, followed by recommended dose of NPK + Sulfur (0.16%).

OTHER DEVELOPMENT ACTIVITIES

Radio Talks	15
TV Talks	05
Capacity Building Program	25
Seminar	12
Urdu/English Articles	03
Farmer Gathering	12
Conferences	02
Class Visited	10
Internee/M.Sc.	07
Special Meetings	05
Grower Visited	68
Orchard Visited	38
Mango nursery plants sold	3535

RESEARCH PUBLICATIONS

- Naqvi, SAH, R. Perveen, A Rehman, T Khan, MT Malik, S Chouhan, A Tariq, S Akram and SH Abbas. 2016. Outbreak of bacterial apical necrosis of mango in Multan, Punjab, Pakistan. Pakistan Journal of Phytopathology. 28(01): 107-113.

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