

# ANNUAL TECHNICAL ABRIDGE REPORT FOR THE YEAR 2018-19

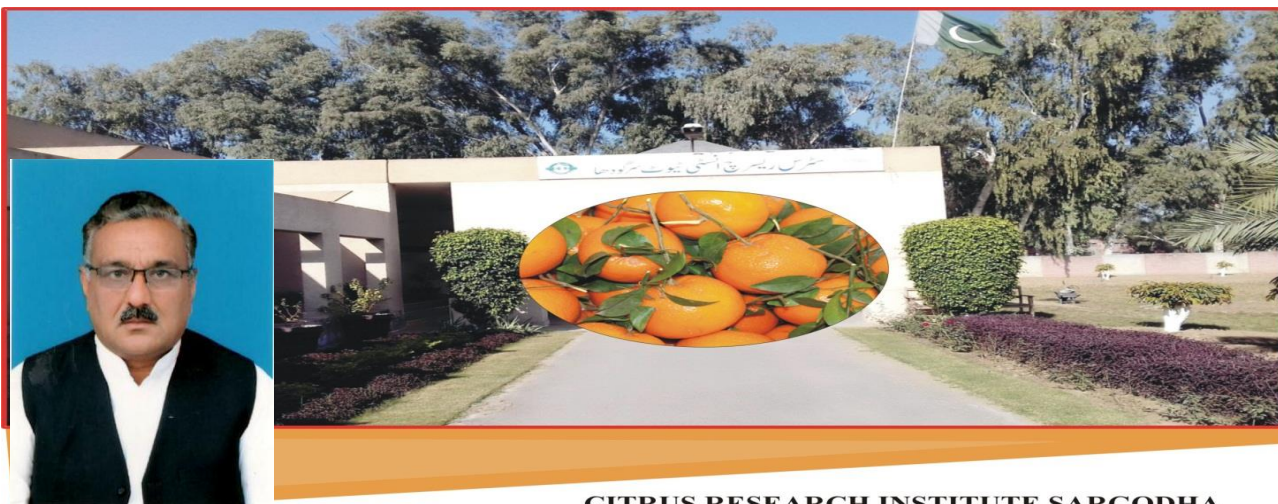
## CITRUS RESEARCH INSTITUTE SARGODHA



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**Muhammad Nawaz Khan**  
**Director**

Ph: 0483-701312 Email: [directorcitrus@gmail.com](mailto:directorcitrus@gmail.com)



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## **OVERVIEW OF THE CITRUS CROP/SECTION**

Citrus cultivars are grown in varying quantities in Countries with tropical or sub-tropical climate. In Pakistan Citrus is the most important fruit crop. In Punjab they are grown on the most area-1,77, 216 hectares and the production is 21,16,466 MT(Source: Crop Reporting Service-2017-18). Citrus is grown in all four Provinces of Pakistan but Punjab produces over 95% of the crop. Breakup of citrus varieties shows that kinnow is dominant due to its popularity in local market and export potential. Kinnow is the major fruit crop of Sargodha Division, hence a full-fledged Citrus Research Institute Sargodha was established in this city during the year 2003-04 by the Government. With the struggle of Scientists of this institute, it has become possible to get approved 09 citrus varieties viz Pak kinnow, CRI Salustiana, SG Feutrell's early, AARI Seedless kinnow, AARI, Khatti, CRI Blood Malta, CRI Musambi, Pak Shamber & Punjab Taracco during the last five years. The institute has established four screen houses to produce disease free nursery plants. It is also focusing on maintenance of Germ Plasm of seedless varieties and is also producing seedless nursery plants as well. This Institute has successfully conducted different research trials on Cultural, Pathological, Entomological, Soil science and Post-harvest aspects during the year. The contribution of this institute towards control of citrus fruit fly, efficient use of water, control of diseases is also admirable. The institute is also working for diversification of different citrus cultivars and for this purpose it has got registered citrus model nursery at the institute and is producing thousands of true to type citrus nursery plants. This institute has also established a block comprising on exotic varieties of citrus i.e. Daizy Mandarin, Caffin mandarin, Harward Blood, Ryan Navel, Mc Mohn Valencia, Cara Cara Naval, Arnald Blood, Early Valencia & Cock Tail to study their adaptability. This Institute has also introduced a Mechanical Citrus tree pruner for the purpose of pruning of old citrus orchards to bring them under phase of rejuvenation. This institute has also established four multiplication blocks of seedless kinnow for its further propagation. The Scientists of this institute has also started citrus breeding programme during this year and completed more 2000 crosses between the varieties. The institute has also arranged Farmer Days for the Exhibition of fruit of different citrus varieties and technical guidance of the citrus growers. The Scientist of this institute are also rendering advisory services through farmer gathering and individual orchards visits for the capacity building of the farmers. In this way this institute is playing its role for the progress of citrus sector.

## **HORTICULTURE SECTION**

### **1-To evaluate the performance of different strains of seedless kinnow (citrus reticulata blanco) under soil & climatic condition of Sargodha.**

This trial was started for the period 2015-2024 to select best strains of seedless Kinnow under soil and climatic condition of Sargodha. There were eight treatments comprising on various strains of seedless kinnow as given below.

T<sub>1</sub> Strain-1 (BW source-Dr. Shujat orchard R-9, P2), T<sub>2</sub> Strain-2 (BW source Dr. Shujat orchard R-5, P-2), T<sub>3</sub> Strain-3 (BW source Sultan Farm Vehari, Line 1 P-19), T<sub>4</sub> Strain-4 (BW source Sultan Farm Vehari, Line 1 P-11), T<sub>5</sub> Strain-5 (BW source Sultan Farm Vehari, Line 1 P-7), T<sub>6</sub> Strain-6 (BW source Asad Tiwana Farm Fsd), T<sub>7</sub> = Strain-7 (BW source-Dr. Shujat orchard GFT Sgd) & T<sub>8</sub> Strain-8 (BW source Asad Tiwan Farm GFT Sgd).

In lay out plan there were five replications having one plant as experimental unit. The plants are now four years old. The growth data taken during this year indicated that T<sub>3</sub> plant attained maximum height i.e. (148.13 cm) followed by T<sub>4</sub> plants which depicted height upto (142.03 cm). Similarly when analysis of fruit was taken in to account, it revealed that T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> & T<sub>5</sub> plants showed (Zero seed) in their fruits while only one seed was recorded in the fruits of T<sub>4</sub> & T<sub>6</sub> strains. It was also observed that maximum fruit weight (195.45 gm) and fruit size (74.73 mm) was recorded in T<sub>4</sub> plant. TSS was maximum (9.75%) in T<sub>1</sub> & T<sub>3</sub> plants. Similarly maximum juice weight (71.5 gm) was also observed in T<sub>4</sub> strains.

**Fig. 1**



**Fig.1** Cross section of AARI Seedless kinnow showing seedless status of fruit

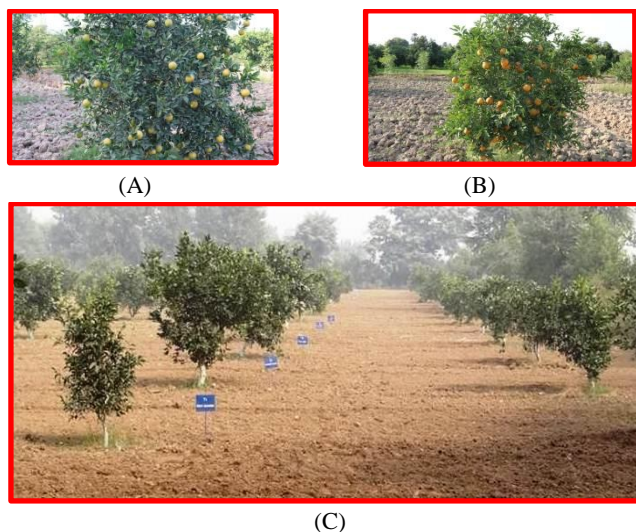
### **2- Effect of GA<sub>3</sub> application on fruit size of Feutrell's Early (citrus reticulata).**

This trial was started for the period 2017-2020 at Govt. orchard of CRI, Sargodha to see the effect of GA<sub>3</sub> on improving the small fruit size of Feutrell's Early. There were four treatments and four replications in this experiment. For these treatments 10, 20 & 30 ppm concentration of GA<sub>3</sub> was prepared to compare them with control. The treatments were applied after fruit set at cell division stage (pea size) to get the desired results. When analysis of fruit was done, it was observed that the application of GA<sub>3</sub> @30 ppm resulted single fruit weight as (123.65 gm) as compared to the control (105.80gm). When fruit size was analyzed it revealed that maximum fruit size (65.86mm) was recorded in the result of treatment four as compared to the control (T<sub>1</sub> = 62.9 mm) for the year under report.

### **3- Performance of different exotic varieties under Sargodha condition on local root stock.**

The trial was started in Govt. orchard of CRI, Sargodha to see the performance of the exotic varieties under Sargodha condition. The experiment started during the month of May, 2015. Ten varieties were kept under observation and these were named as T<sub>1</sub> Salustiana, T<sub>2</sub> Daisy mandarin, T<sub>3</sub> Harward Blood, T<sub>4</sub> Ryan Navel, T<sub>5</sub> Mc mohan Valencia, T<sub>6</sub> Cara Cara Navel, T<sub>7</sub> Clemenules, T<sub>8</sub> Ornard blood, T<sub>9</sub> Caffin & T<sub>10</sub> as Early Valencia. There were three replication and one plant as experimental unit in each treatment making total of 30 plants. While taking data it was observed that four varieties out of ten exercised flowering during the year 2018. When yield data was analyzed in the lab. It depicted that Harward blood produced maximum single fruit weight (182.2 gm) along with considerable fruit size (70.4 mm) when it was compared with other sweet orange varieties. Clemenules exercised flowering among the mandarin variety and resulted in yield. This variety attained fruit weight (134.3 gm), fruit size (71.4 mm). Mc mohan Valencia and Arnold blood proved themselves as less seed variety having (1-3 seeds/fruit) respectively.

Fig. 2

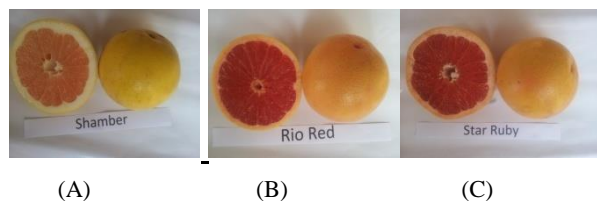


**Fig-2** (A) An exotic variety of sweet orange variety i.e. Harward blood came on to bearing after four years of its plantation. This variety has attained good fruit size (70.4mm), single fruit weight (182.2gm). (B) An exotic variety of mandarin namely Clemenule has entered into reproductive phase after four years of its plantation. This variety has shown good fruit weight (134.3 gm) along with 65.2 gm juice/fruit. (C) The picture is showing the trial site where ten exotic varieties brought from Australia has been planted at CRI, Sargodha to see their adaptability under local soil and climatic conditions.

#### 4- Comparative studies on four pigmented grapefruit varieties under local soil and climatic conditions.

This study was conducted to compare the performance of three imported grapefruit varieties with shamber grapefruit in terms of yield and fruit quality under local soil and climatic conditions. For this purpose four varieties were brought under study as T<sub>1</sub>Shamber, T<sub>2</sub>Flame, T<sub>3</sub>Star Ruby, T<sub>4</sub> Rio Red. Statistical data revealed that maximum ave. height of 3.8 m, spread of 5.1 m, Max. fruit yield of 397/plant and max. fruit size of 8.3/8.2 cm was observed in T<sub>2</sub>. Max. fruit juice of 139.0 gm was noted in T<sub>4</sub> whereas maximum TSS of 7.6% was found in T<sub>2</sub>.

Fig. 3



**Fig.3** (A) Picture of Shamber grape fruit. (B) Picture of Rio Red grape fruit. (C) Picture of Star Ruby grape fruit

#### ENTOMOLOGY SECTION:

##### 5- Establishment of baseline susceptibilities to some conventional and new insecticides in mealybug (*Drosicha mangiferae*) in CRI Sargodha, Pakistan under laboratory conditions.

This research trial was conducted in the Entomology laboratory of CRI, Sargodha to determine the toxicities of various insecticides against adult female of *Drosicha mangiferae*. This research work was done in the year 2018 when mealybug population was available in the orchards. Eleven insecticide formulations viz Bifenthrin, Fenprothrin, Deltamethrin, Methidathion, Chlorpyrifos, Malathion, Imidacloprid, Acetamiprid, Thiamethoxam, Spirotetramat, & Flonicamid at five different concentrations (treatments) were tested in the laboratory on the adult mealybug (female) collected from field. Each treatment (concentration) was replicated five times. Diluted concentrations of each insecticide were prepared and citrus leaf-dip bioassays were conducted. After dipping the leaves in insecticide solutions, they were dried for one hour and put in the Petri-dishes. In each Petri-dish 10 insects were released to allow feeding on insecticide treated leaves. Each insecticide concentration was replicated five times and 50 insects were used per concentration. Hence 300 insects were used in a single bioassay including control consisting of leaves treated with water. Mortality of insects was determined after 48 and 72 hours. The mortality data was subjected to statistical analysis by using Probit Analysis Program to determine the LC<sub>50s</sub> and other related statistical parameters. Toxicity of bifenthrin, spirotetramat and flonicamid was statistically similar to each other (their 95% FLs overlap); however, spirotetramat and flonicamid exhibited statistically greater toxicities as (their 95% FLs did not overlap) compared to deltamethrin, fenprothrin, methidathion, chlorpyrifos, imidacloprid, acetamiprid and thiamethoxam. Toxicity of

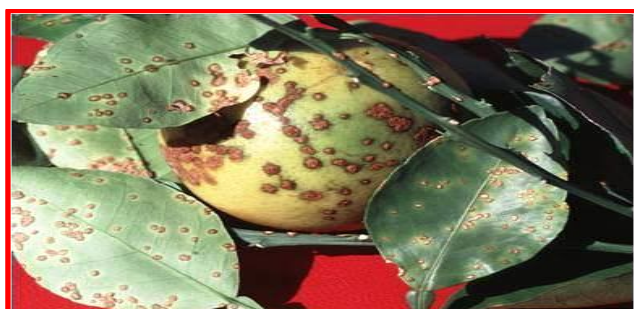
bifenthrin was similar to fenpropathrin (their 95% FLs overlap) but greater than that deltamethrin (their 95% FLs did not overlap). Toxicity of thiamethoxam was greater than acetamiprid, chlorpyrifos, and deltamethrin (their 95% FLs did not overlap). In conclusion, insecticides bifenthrin, spirotetramat, flonicamid and thiamethoxam are recommended due to their higher toxicities against adult female of *Drosicha mangiferae* based upon the laboratory findings.

### **PLANT PATHOLOGY SECTION :**

#### **6- Evaluation of different fungicides against citrus canker (*Xanthomonas axonopodius pv.citri*.)**

This trial was started during the year 2015 comprising on ten treatments having different doses of chemicals to see their effects on the control of citrus canker. The spray of each chemical was done in four different intervals of plant growth during the months of March, April, August & September. After application of treatments, disease data was collected for its comparison with the data collected before the spray programme (control). Data revealed that the treatment T<sub>4</sub> (Bordeaux Mixture @ 1 %) proved its self-best treatment to decrease the disease on leaves upto the level of 88% when it was compared with control. Next suitable results were seen in case of application of T<sub>1</sub> (Copperhydroxide @ 2.5 gm/lit. of water) which exhibited 84% decrease in the aforesaid disease over control followed by T<sub>8</sub> (Onion Extract) with ultimate output of 73% decrease in disease as compared to the control.

**Fig. 4**



**Fig.4** Symptoms of citrus canker on fruit as well as on leaves of citrus plants

#### **7- Comparative studies on the Efficacy of different chemicals to control citrus scab (*Elsinoe fawcettii*) and citrus melanose (*Diaporthe citri*) in kinnow**

This trial was started to find out the most suitable fungicide against citrus scab & citrus melanose diseases in kinnow during the year 2017. The study will go on upto 2020. There were eleven treatments comprising on spray of different chemicals for selecting suitable fungicide against the aforesaid diseases. Four sprays were done each before flowering in March, after fruit setting in April & in the month of August & September respectively. The data were collected after one month the last spray of chemical. Treatment T<sub>10</sub> (Bordeaux mixture 1%) proved itself the most effective treatment by decreasing the level of disease upto 88% as compared to the control. Second best result was obtained from T<sub>5</sub> (Copper Hydroxide) @2.5gm/lit.of Water) which decrease the disease upto 81% over control. 3<sup>rd</sup> best treatments was T<sub>3</sub> (Difenoconazole+Azoxystrobin) @1ml/lit. of Water) which decreased the disease upto 74% as compared to the control.

**Fig. 5**



**Fig. 5 (A)** Symptoms of citrus melanose on kinnow fruit. **(B)** Symptoms of citrus scab on kinnow fruit

#### **8- screening of orange varieties against citrus canker (*Xanthomonas axonopodis pv.citri*.)**

The present study was initiated to screen out the most resistant orange varieties against citrus canker disease. The experiment was laid down in RCBD involving 12 orange varieties/treatments, with 04 replications. Different varieties/treatments were as T<sub>1</sub> (Musambi), T<sub>2</sub> (Succari), T<sub>3</sub> (Blood Red), T<sub>4</sub> (Valencia late), T<sub>5</sub> (Salustiana), T<sub>6</sub> (Taracco), T<sub>7</sub> (Jaffa), T<sub>8</sub> (Kozan), T<sub>9</sub> (Marss Early), T<sub>10</sub> (Pine Apple), T<sub>11</sub> (Casa Grande), T<sub>12</sub> (Washington Navel). To observe the response of individual treatment, the observations were collected for statistical analysis which indicated that T<sub>1</sub> (Musambi) proved most

resistant variety against citrus canker followed by T<sub>2</sub> (Succari) and T<sub>3</sub> (Blood Red).

Fig. 6



Fig.6 Symptoms of citrus canker disease on kinnow leaves

### SOIL SCIENCE SECTION:

#### **9- Development of economical fertilizer programme to increase the qualitative yield of kinnow**

The objective of the present study was to evaluate the cost effective nutritional programme for improving the yield and quality of kinnow mandarin. The experiment was laid down in RCBD and the treatments include as T<sub>1</sub>: NPK (1000-500-500 g plant<sup>-1</sup>), T<sub>2</sub>: 75 % N (urea) + 25 % N (FYM), T<sub>3</sub>: 50 % N (urea) + 50 % N (FYM), T<sub>4</sub>: 75 % N (FYM) + 25 % N (urea), T<sub>5</sub>: 75 % N (urea) + 25 % N (poultry manure), T<sub>6</sub>: 50 % N (urea) + 50 % N (poultry manure), T<sub>7</sub>: 75 % N (poultry manure) + 25 % N (urea), T<sub>8</sub>: 75 % N (urea) + 25 % N (compost), T<sub>9</sub>: 50 % N (urea) + 50 % N (compost), T<sub>10</sub>: 75 % N (compost) + 25 % N (urea). The collected data was statistically analyzed and concluded that the Urea and Poultry manure was found the best suitable combination in producing higher yield (196.25kg/tree) where 75% nitrogen from urea and remaining 25% from poultry manure (T<sub>5</sub>) was applied. Benefit cost ratio (B/C ratio) was also calculated for all the treatment combinations. Higher B/C ratio (6.14) was also obtained from T<sub>5</sub> while lowest (-0.11) in T<sub>10</sub> where 75% nitrogen (compost) & 25% nitrogen (Urea) was applied.

#### **10- Studies on the foliar feeding of Zn, Cu and B on yield and quality of citrus cv. kinnow.**

The present experiment was initiated during the year

2015-16 with main objective of enhancing yield and quality of kinnow mandarin besides improving tree health. The deficiencies of different micronutrients lead the tree toward declining side and resulted in poor quality & yield of fruit. The experiment was laid down in RCBD with eight treatments as

T<sub>1</sub>: NPK (1000-500-500 g plant<sup>-1</sup>) (control) T<sub>2</sub>: T<sub>1</sub> + Zn foliar application @ 1000 ppm (0.3 % ZnSO<sub>4</sub>, T<sub>3</sub>: T<sub>1</sub> + B foliar application @ 60 ppm (0.05 % Borax), T<sub>4</sub>: T<sub>1</sub> + Cu foliar application @ 500 ppm (0.2 % CuSO<sub>4</sub>), T<sub>5</sub>: T<sub>1</sub> + Zn+ B foliar application, T<sub>6</sub>: T<sub>1</sub> + Zn+ Cu foliar application, T<sub>7</sub>: T<sub>1</sub> + Cu+ B foliar application and T<sub>8</sub>: T<sub>1</sub>+ Zn + Cu + B foliar application. Two plants of uniform size were selected for each treatment with three replications i.e. total 48 trees constituted under this experimental study. Micronutrients were applied to the selected trees at three different stages i.e. before flowering initiation, after fruit setting and after appearing of new flushes (August/September). The data was subjected to statistically analysis which indicated that higher fruit yield (177.88 kg/tree) was obtained from T<sub>8</sub> where combined Zn + Cu + B were applied through foliar spray. Higher benefit cost ratio (2.22) was also obtained from T<sub>8</sub> and low (2.0) from T<sub>1</sub> where only NPK fertilizers were applied.

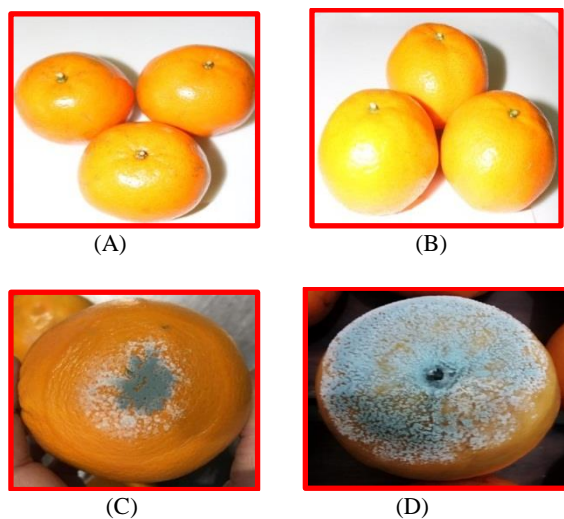
### POSTHARVEST SECTION:

#### **11- Application of various salts in wax for controlling postharvest decay in mandarin fruits.**

The object of this trial was to control the post-harvest decay of mandarin varieties i.e. Kinnow & Willow leaf by incorporating different salts in wax to replace fungicide. Mostly post-harvest decay in citrus fruit is caused by green and blue molds called as *Penicillium Digitatum* and *Penicillium Italicum* respectively. In order to provide extra barrier to post-harvest decay different salts were tested in substitution of fungicide by adding in commercial wax. Various salts were incorporated in the commercial wax to measure the role of salt activity for controlling of post-harvest rots in the citrus mandarin varieties i.e. Kinnow and Willow leaf.

Sodium carbonate, Sodium bicarbonate, potassium carbonate, Potassium bicarbonate, Potassium Sorbate, at 6% (w/v) concentration were compared with control treated through only commercial wax and a treatment treated through commercial wax in combination with fungicide i.e. Thiabendazole. Fruit was stored for 45 days at  $4\pm 1\text{ C}^\circ$  followed by one week of shelf life at  $20\pm 2\text{ C}^\circ$  to check the marketing shelf life. The best results for decay incidence and weight loss during storage study of both citrus varieties were observed in a treatment done with fungicide used in combination with wax (1.2%, 2.5%) which was followed by a combination of wax used with 6% (w/v) Potassium Sorbate (2.8%, 4.8%). Whereas better decay control was achieved in all other treatments used by incorporating different salts instead of using wax alone (13.5%, 7.8%). The results of the study depicts that incorporation of salts to wax in substitution to the fungicide is an effective application to control post-harvest citrus fruit decay with additional benefits of safety, easy to handle and inexpensive approach.

**Fig. 7**



**Fig.7** (A) picture of kinnow fruit. (B) Picture Willow leaf fruit (C) Infection of blue mold in kinnow. (D) Infection of green mold in kinnow

## DETAIL OF ON GOING PROJECTS

### 1. Development of integrated management of citrus orchards to enhance the yield and improvement of fruit quality

#### Targets for the year 2018-19:

- 05 demonstration trials will be conducted in farmer orchards at Sargodha District.
- 05 thousand disease free nursery plants will be produced.
- 02 thousand less seeded nursery plants will be produced.
- 02 farmers gatherings will be held at Sargodha District.
- Dissemination of developed IPM strategy through electronic and print media.

#### Achievements against the targets:

- 05 demonstration trials have been conducted at Farmer fields in Sargodha District.
- 05 thousand disease free nursery plants has been prepared.
- 02 thousand less seeded nursery plants has been prepared.
- 01 farmers gathering has been conducted so far by this institute.
- Advisory services are being rendered through electronic media while brochures will be published with the online of budget

### 2. Diversification to high value cropping through promotion of Horticulture

#### Targets for the year 2018-19:

- 6000 seedless kinnow plants to be produced by CRI, Sargodha.
- 9000 supply of bud wood to the private registered nurseries.
- Two trainings to the registered nurserymen
- Two Farmers Days by CRI, Sargodha

#### Achievements against the targets:

- 6000 plants have been prepared at Govt. Nursery CRI, Sargodha.
- 6000 bud wood of seedless kinnow has been provided to the private registered nurseries so far.
- One training has been given to the registered nurserymen so far.
- One Farmers Day/seminar has been conducted by CRI, Sargodha so far.

### 3. PARB project no. 904 "Nutrition Enhancement of Crops, Fruits, Vegetables

and their products under climate change scenario.

**Targets for the year 2018-19:**

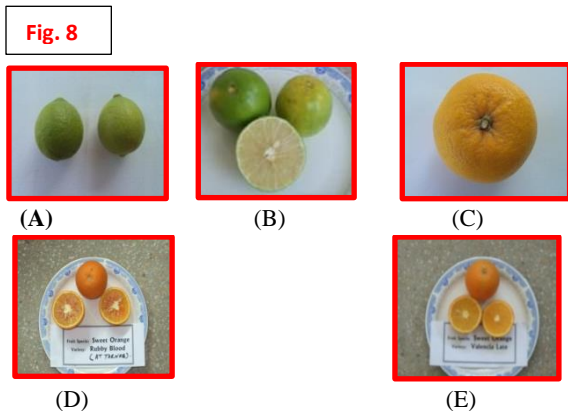
- Citrus orchard management practices at selected trials sites.
- Soil and leaf analysis of selected sites.
- Quality and nutritional analysis of fruit of all trial sites.
- Conduction of storage studies of kinnow from all sites.
- Production of standardized citrus products.

**Achievements against the targets:**

- Orchard management practices were performed on all selected sites.
- Soil and leaf analysis of all sites shall be completed uptill September, 2019.
- Quality and nutritional analysis of kinnow fruit from all five sites completed.
- Storage study of kinnow fruit of all trial sites completed.
- Products on lab scale were prepared for further evaluation.

**MISCELLANEOUS:**

- DUS tests of five citrus varieties i.e. Sweet lime, Kaghzi Lime, Succari, Ruby blood & Valencia late was completed as a first step towards variety approval.



**Fig.8** (A) Kaghzi lime. (B) Sweet lime. (C) Succari. (D) Ruby blood. (E) Valencia late

- Established Constant & Climate Chamber at CRI, Sargodha to enhance the shelf life of fruit of various citrus varieties.

**Fig. 9**



**Fig. 9** Constant Climate Chamber established at CRI, to study the shelf life of citrus fruits

- Established Water Reservoir to harvest rain water and store canal water for irrigation purpose.
- Introduce Mechanical citrus tree pruner for pruning citrus orchard on large scale with in limited time.

**Fig. 10**



**Fig.10** (A) Director Citrus briefing about the technology of mechanical pruning in citrus to the citrus growers. (B) Demonstration of mechanical citrus tree pruner in Govt. orchard of CRI, Sargodha.

**OTHERS:**

- Soil & water samples analyzed = 350
- Disease sample analyzed = 123
- Radio Talks delivered = 08
- TV Talks delivered = 01
- Popular Urdu Articles = 07
- Research Paper published = 04
- Abstracts published = 09
- Training delivered = 23
- Internship students = 16
- Training received = 07
- Foreign training received = 01
- Seminar/Exhibition = 02
- Books/manual Published = 01



## **SENIOR RESEARCH STAFF:**

### **Horticulture Section:**

Muhammad Nawaz Khan, Director

0301-6710434, [directorcitrus@gmail.com](mailto:directorcitrus@gmail.com)

Abdul Aziz, Horticulturist,

0300-6008677, [abdul.aziz8677@gmail.com](mailto:abdul.aziz8677@gmail.com)

Imran Muhammad Siddique, Horticulturist

0333-6912169, [horticultristsahiwal@gmail.com](mailto:horticultristsahiwal@gmail.com)

Muhammad Raza Salik, Assistant Horticulturist,

0345-8047454

[razasalikcri@gmail.com](mailto:razasalikcri@gmail.com)

### **Soil Science section:**

Imtiaz Ahmad Warriach Assistant Agri. Chemist.

0334-7523292, [warrachimtiaz@yahoo.com](mailto:warrachimtiaz@yahoo.com)

### **Plant Pathology Section:**

Abdul Rehman, Assistant Plant Pathologist,

0300-6037325, [qalandar68@gmail.com](mailto:qalandar68@gmail.com)

### **Food Technology Section:**

Mr. Ehsan-ul-Haq, Assistant Food


Technologist, 0300-9602855

[awanehsan101@hotmail.com](mailto:awanehsan101@hotmail.com)

### **Entomology Section:**

Naima Din Assistant Entomologist

0336-3311282, [naima\\_noor83@hotmail.com](mailto:naima_noor83@hotmail.com)

  
Muhammad Nawaz Khan  
Director,  
Citrus Research Institute,  
Sargodha 