

ANNUAL PROGRESS REPORT

FOR THE YEAR

(2019 – 2020)

**HORTICULTURAL RESEARCH INSTITUTE,
AARI, FAISALABAD**

CONTENTS

| Sr.# | TITLE | Page # |
|------|--|--------|
| 1. | Overview: Horticultural Research Institute, Faisalabad | 4 |
| 2. | Organizational structure | |
| 3. | Budget | 5 |
| 4. | Horticultural Research Institute, Faisalabad Experimental details | 5 |
| 5. | Suitable time for rooting of Guava (<i>Psidium guajava</i> L.) soft wood cuttings immersed with Indole Butyric Acid (IBA) | 6 |
| 6. | Studies on suitable time of budding/ grafting in Guava (<i>Psidium guajava</i> L.) | 7 |
| 7. | Effect of different planting densities on growth, yield and fruit quality of guava | 9 |
| 9. | Establishment of progeny garden of guava | 9 |
| 10. | Characterization of induced mutants in guava strains | 11 |
| 11. | Evaluation of different strains of Seedless Kinnow (<i>Citrus reticulata</i> Blanco) under Faisalabad climatic conditions | 12 |
| 12. | Response of jamun (<i>syzygium cummini</i>) to different asexual propagation techniques and propagation time | 13 |
| 13. | Collection and maintenance of jamun germplasm | 16 |
| 14. | Standardization of IBA concentration in relation to planting time for rooting of jamun semi-hard wood cuttings | 17 |
| 15. | Hybridization of germplasm for development of new varieties of pomegranate | 19 |
| 16. | Efficacy of various chemicals to control bacterial blight in Pomgranate (<i>Punica granatum</i>). | 20 |
| 17. | Performance of different grape varieties under climatic conditions of Faisalabad | 21 |
| 18. | Standardization of blanching time on different varieties of dates for making dry dates (chohara) | 22 |
| 19. | Development of chance seedling varieties of date palm from exotic cultivars at agro-climatic conditions of Faisalabad | 23 |
| 21. | Standardization of suitable temperature for processing/ dehydration of dates | 26 |
| 22. | Adoptability of various fig strains under climatic conditions of Faisalabad | 28 |
| 23. | Introduction of olive cultivars under Faisalabad conditions | 30 |
| 24. | Impact of plant growth regulators on growth and yield of strawberry (cv. chandler) | 31 |
| 25. | Metrology of Faisalabad (2019-20) | 32 |
| 26. | Date Palm Research Sub-Station, Jhang: An Overview | 33 |
| 27. | Varietal performance of different exotic date palm cultivars under central Punjab condition | 33 |
| 28. | Effects of thinning on fruit quality and yield of date palm Dhakki | 34 |

| | | |
|-----|---|----|
| | variety | |
| 29. | Horticultural Research Station, Bahawalpur | 35 |
| 30. | Impact of climate regimes on production and quality of exotic Date palm (<i>Phoenix dactylifera</i>) germplasm. | 36 |
| 31. | Performance evaluation of exotic germplasm of Date palm at Bahawalpur | 39 |
| 32. | Characterization and documentation of Date Palm (<i>Phoenix dactylifera</i>) and Ber (<i>Ziziphus mauritiana</i>) germplasm | 41 |
| 33. | Integrated approach to control cracking of fruit in Pomegranate (<i>Punica granatum L.</i>) | 43 |
| 34. | Studies on genetic diversity of exotic Date palm seedlings under climatic conditions of Bahawalpur | 44 |
| 35. | Publications | 46 |
| 37. | Horticultural Scientists | 48 |

OVERVIEW:

Being an agricultural country, Pakistan is highly dependent upon agriculture for its survival as agriculture is the core of the economy of the country. Horticultural corps are very important for

humans. Currently, the world is observing a drastic climate change and Pakistan did not remain unaffected. Agriculture as well as horticulture sector of the country is witnessing problems related to crop production. Horticulture, which contributes majorly in the agriculture export sector of Pakistan, is unfortunately much neglected. Citrus and mangoes are most important horticultural commodities which are the primary export items from Pakistan and are highly recognizable all over the world. Pakistani horticultural export commodities, especially *Citrus* and *mango* which have a large share in export, are facing quality issues. Therefore, the present scenario calls the agricultural researchers to put their energies on finding out the solutions of problems so that we can not only meet our domestic fruit demand but also catch the international markets of Middle East. Horticultural Research Institute, Faisalabad since its establishment is working for the wellbeing of the fruit growers with the ultimate goal of raising the country in quality fruit production. Keeping in view the big challenge of changing climatic conditions the Institute is carrying out research studies on climate smart horticulture. Development and dissemination of processing technology for date fruit in order to avoid crop loss at dung stage resultant of before monsoon rains (pre-monsoon) is its clear example. Lack of approved varieties is also a bottle neck in quality fruit production and research team of HRI feels proud to share that varietal registration procedure for a number of fruit crops (Date palm, Ber, Pomegranate, Guava) has been initiated during last two years. It is a matter of satisfaction that the pace of development of area under fruit crops is raising continually when we compared with past. Citrus is our major export commodity and seedlessness is consumer demand, Horticultural Research Institute is in the way to achieve its goal of developing its own pure seedless kinnow accession. Certified nursery plants of various fruits for orchard establishment are being produced by the Institute to cater the requirements of growers from all over the Punjab. Despite of all the mentioned research achievements, However, The institute is still needed to be equipped with infrastructure according to the new era of technology and digital agriculture. Brief research findings, outcomes of activities of scientists going on at Institute and allied research stations, are portrayed in the following:

ORGANIZATIONAL STRUCTURE:

Technical Staff Position:

| Name of post | No. of Posts | In Position | Vacant |
|----------------------------|---------------------|--------------------|---------------|
| Director | 01 | 01 | 0 |
| Horticulturist | 03 | 02 | 01 |
| Assistant Horticulturist | 06 | 06 | 00 |
| Assistant Research Officer | 14 | 14 | 00 |
| TOTAL | 24 | 23 | 01 |

BUDGET:

| Code classification | Allocation for 2019-20 | Expenditure for 2019-20 |
|------------------------------|-----------------------------------|------------------------------------|
| A01101-Pay of officers | 16500310 | 16455874 |
| A011-2-Pay of staff | 23609000 | 23580693 |
| A012-1-Regular Allowances | 33966815 | 33630503 |
| A012-2-Other Allowances | 1650300 | 1637160 |
| 4000-Repair & Maintenance | 1195120 | 1194527 |
| 50000-Commodities & Services | 10355600 | 10302672 |
| Total | 87277145 | 86801429 |

HORTICULTURAL RESEARCH INSTITUTE, FAISALABAD

1. Suitable time for rooting of Guava (*Psidium guajava* L.) soft wood cuttings immersed with Indole Butyric Acid (IBA)

Guava is propagated through seeds conventionally that results in variation of valuable genetic traits. However, due to hard nature of seed coat, guava propagation through seeds remained a challenging job. Vegetative propagation of guava (through cutting) is highly desirable, yet multiple factors are responsible for success of the technique. The key factors include cutting type, time of propagation and growing media used for nursery plants production. Current investigation was carried out to find the best planting time (February, March, August, September) for root induction and survival of IBA treated (0.2%, 0.4%, 0.6%) guava softwood cuttings (GSWCs). Cuttings (15 cm long) having 4-5 buds of young leaves were taken from current season growth of five years old guava plant (var. *Gola*). Treatment of cuttings with 0.4% IBA and plantation during September showed highest survival percentage (63.5%) (Fig.1), increase in branch length (16.1 cm) (Fig. 2), and number of leaves per plant (27.3) recorded after 60 days (Fig. 3). Cuttings of control treatment exhibited minimum success percentage (11.3%) and leaves per plant (7.3) when planted in February; however least increase in branch length (3.8 cm) when planted in March. The results of current investigation suggest that treatment of guava softwood cuttings with 0.4% IBA (4000 mg dissolved in one liter of water) may be used for commercial propagation of guava through softwood cuttings. Furthermore, the month of September was found best planting for guava vegetative propagation through cuttings.

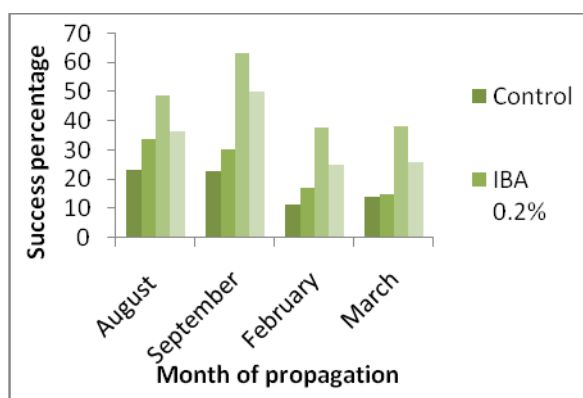


Fig. 1: Effect of IBA on success percentage of GSWCs

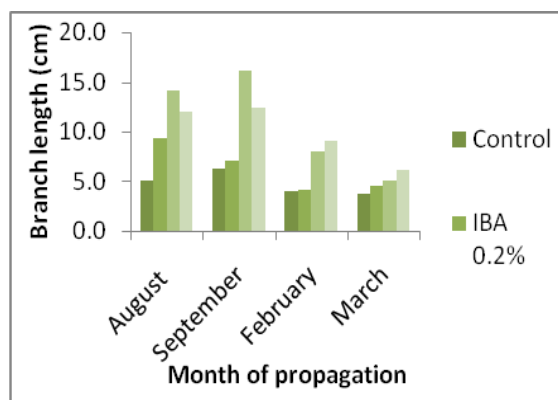


Fig. 2: Effect of IBA on branch length of GSWCs (60 days of plantation)

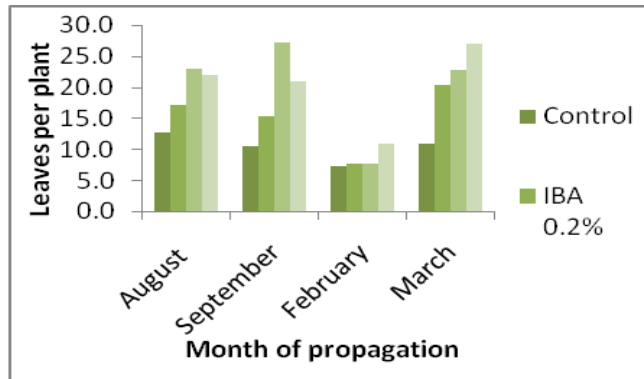


Fig. 3: Effect of IBA on number of leaves per plant of GSWCs (60 days of plantation)



Fig. 4: Full grown guava nursery plants developed from softwood cuttings after transplantation

2. Studies on suitable time of budding/ grafting in Guava (*Psidium guajava* L.)

Guava has been valued for its nutritional benefits particularly “vitamin C” contents. It is also a regular heavy bearer fruit plant and farmers get good remuneration from guava orchards. Therefore, farmers’ trend for guava orcharding on commercial scale is gaining momentum. Albeit, conventional method of propagation through seeds being used by farmers is easy, yet it

results in segregation of productive genetic characters. Therefore, it was direly needed to develop protocols, which can provide uniform, high quality genetically predictable stocks. Hence, a brief study was carried out to compare success of different vegetative propagation means i.e., T-budding, T-grafting and cleft-grafting with respect to suitable time for commercial propagation of guava for production of true to type plants. T-grafting gave highest success percentage (53.0%) (Fig.5) and produced maximum increase in shoot length (30.2cm) (Fig.6), when grafting was carried out during October. Lowest mean values (11.5%) were noted in case of cleft-grafting when carried out in the month of October (Fig.6). Maximum days were taken to sprout by the stocks cleft-grafted in October month (40.7 days) (Fig.7). However, minimum shoot length (14.5 cm) was recorded in plants propagated through cleft-grafting in the month of October. Hence based on the current investigations, it can be deduced that guava plants may also be propagated by T-grafting during October month for maximum success and plant survival as well as proper growth and development of sprouted plants.

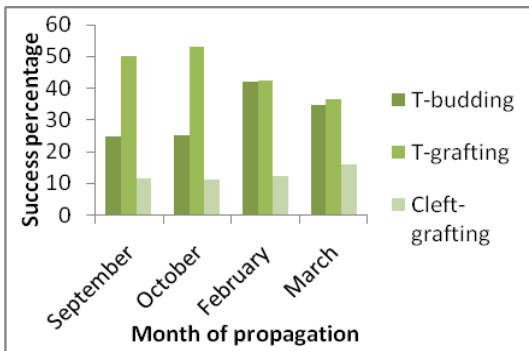


Fig. 5: Effect of asexual propagation technique on success percentage of guava

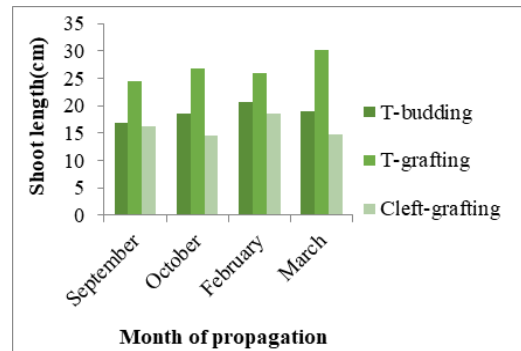


Fig. 6: Effect of asexual propagation technique on shoot length (cm) of guava

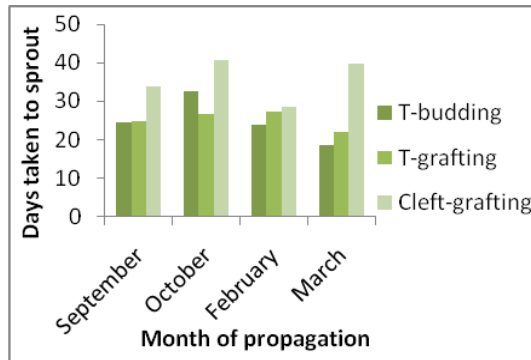


Fig.7: Effect of asexual propagation technique on sprouting duration (days) of guava

3. Effect of different planting densities on growth, yield and fruit quality of guava

In most orchards with standard planting, the plants are set at the corners of square or rectangles of such size as to accommodate the plants when fully grown. The full distance allowed from plant to plant will not normally be required by the plants for early ten to fifteen years, and in the meantime inter plantings can often be done to take the advantage from the fallow land. The majority of guava orchards planted in Pakistan are spaced at 22 ft × 22 ft or 18 ft × 18 ft giving 90 and 134 trees per acre, respectively. But the tendency since 2 decades has been towards closer planting distances. Results of earlier work on density have indicated that closer spacing produce more fruit per acre. Present study was carried out to find the best planting density (12 ft. × 8ft., 10 ft. × 5ft. And 6.5 ft. × 5ft.) for quality guava production (var. *Gola*). Maximum plant spread (33.71cm), maximum plant height (223cm), fruit weight (177g) and plant yield (12.12 Kg) was observed in T₁ while highest number of fruits per plant (73) were harvested from T₂ TSS of fruits harvested.

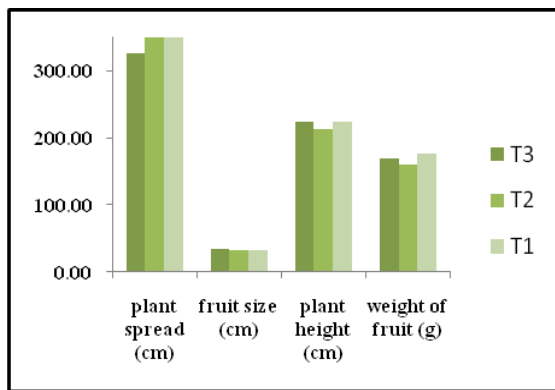


Fig.8: Attributes of Guava grown under High Density Plantation

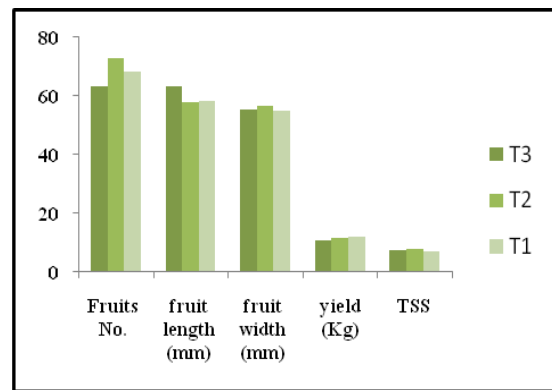


Fig. 9: Attributes of Guava grown under High Density Plantation

4. Establishment of progeny garden of guava

Study was done on evaluation of new existing guava strains in different localities of Punjab to explore their potential. Among all selections, GS-3 gave maximum yield, fruit weight, fruit size with maximum rating for flavor and texture (Table 1&2). This strain also remain low seeded as compared to other strains while in case of TSS was found maximum in GS-5. In future it is possible that GS-3 strain would be desirable for processing industry as it is low seeded. As GS-5 has highest value of TSS, it might become acceptable among

consumer for raw consumption. It is suggested to conduct further studies on these strains to cultivate them commercially.

Table 1: Physiochemical characteristics of guava selections

| Strains | Fruit Yield Kg/tree | Fruit Length (mm) | Fruit width (mm) | Fruit size (mm ²) | Fruit weight (g) | Core length (mm) | Core width (mm) | Core size (mm ²) | Seed No. | Seed Core: pulp | TSS (oBrix) |
|---------|---------------------|-------------------|------------------|-------------------------------|------------------|------------------|-----------------|------------------------------|----------|-----------------|-------------|
| GS-1 | 58.75c | 60.14f | 57.41d | 3452.2fg | 112.75de | 30.792d | 27.88d | 859.1 f | 177.50c | 25.05c | 12.5cd |
| GS-2 | 65.50b | 94.38ab | 60.35cd | 5690.2 c | 170.00 b | 29.41d | 23.10e | 587.3 g | 102.00e | 10.33e | 11.7d |
| GS-3 | 75.50a | 90.95bc | 83.67a | 7606.7 a | 258.75a | 47.13a | 34.03 c | 1605.2 b | 95.00c | 21.30cd | 11.6d |
| GS-4 | 52.75e | 70.16e | 57.05d | 4003.6 e | 109.25 de | 43.28b | 28.12d | 1215.4 d | 178.25c | 21.30cd | 12.1d |
| GS-5 | 59.00c | 60.79f | 54.73d | 3324.8 g | 114.75 cde | 33.70c | 29.83d | 1005.6 e | 329.75a | 30.49ab | 15.8a |
| GS-6 | 58.25cd | 89.02c | 59.93cd | 3324.8 g | 152.25 b | 46.15a | 33.48 c | 1546.0 b | 136.00d | 28.98b | 12.7cd |
| GS-7 | 66.75b | 95.37a | 67.19b | 6410.5 b | 134.75bcde | 43.42b | 46.26 a | 2009.2 a | 199.00c | 28.98b | 12.9bcd |
| GS-8 | 56.25d | 61.34f | 64.20bc | 3939.6 ef | 146.50 bcd | 33.48c | 39.94 b | 1336.8 c | 127.75d | 33.98a | 14.5ab |
| GS-9 | 58.50c | 83.48d | 58.03d | 4844.0 d | 151.65bc | 34.95c | 15.25 g | 532.9 g | 230.25b | 11.03e | 11.9d |
| GS-10 | 31.50f | 53.78g | 57.38d | 3094.9 g | 101.00e | 26.51 e | 23.107e | 612.3 g | 250.00b | 19.96d | 14.1abc |

Table 2: Organoleptic properties of Guava strains

| Treatments | Colour (Score) | Taste (Score) | Flavour (Score) | Texture (Score) |
|------------|----------------|---------------|-----------------|-----------------|
| GS-1 | 5.25cd | 9.00a | 7.50bcd | 7.75ab |
| GS-2 | 6.25bc | 7.25bc | 6.25de | 7.00bcd |
| GS-3 | 8.00a | 8.75a | 9.00a | 8.75a |
| GS-4 | 4.25d | 7.00bc | 7.75abc | 6.25cd |
| GS-5 | 8.50a | 7.75ab | 8.75ab | 7.25bc |
| GS-6 | 5.25cd | 5.50d | 6.25de | 5.00e |
| GS-7 | 6.00bc | 8.00ab | 6.25de | 6.00de |
| GS-8 | 4.25d | 7.00bc | 8.00abc | 6.00de |
| GS-9 | 7.00ab | 6.25cd | 5.00e | 7.00bcd |
| GS-10 | 6.00bc | 7.75ab | 7.00cd | 7.25bc |

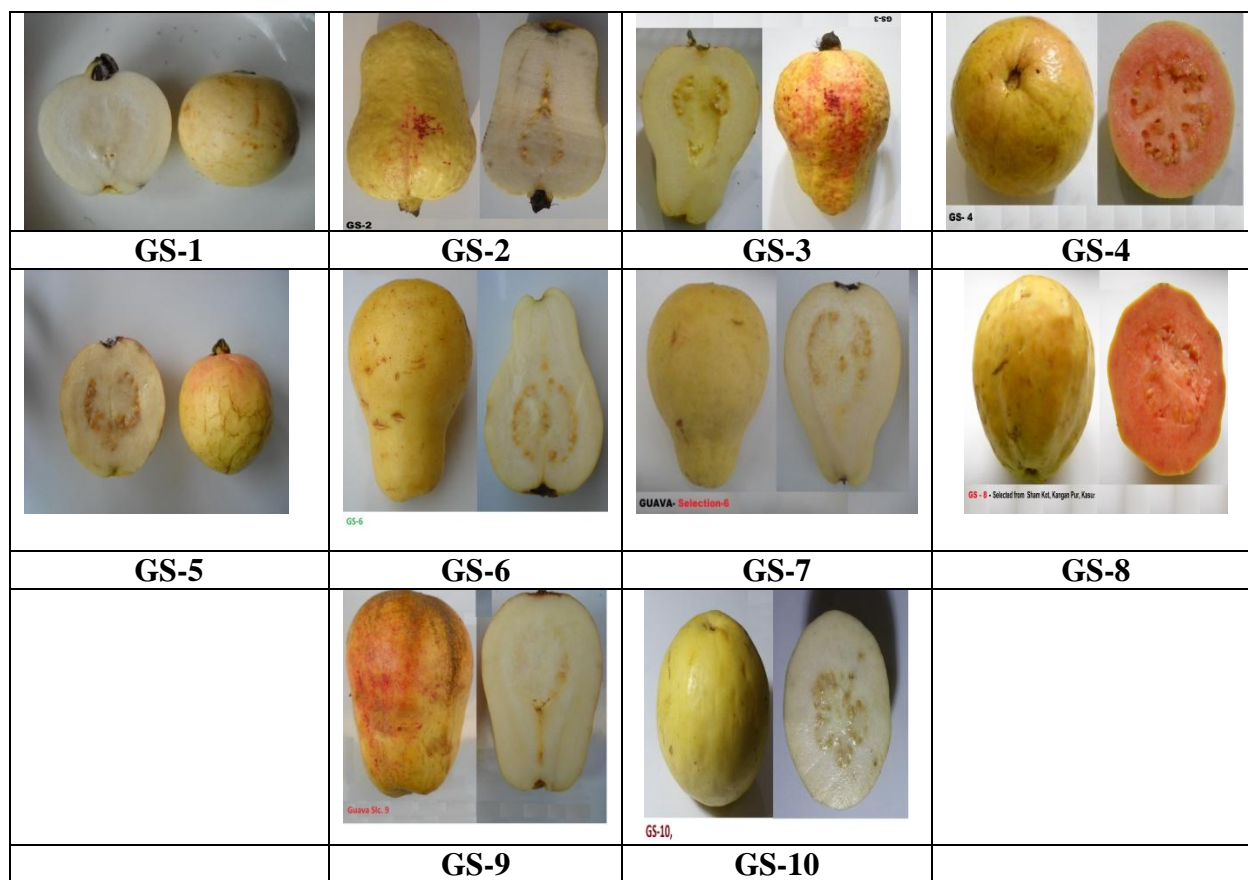


Fig.10: Diversity of Guava strains present in progeny garden of the experimental orchard of Institute

5. Characterization of induced mutants in guava strains

The aim of the study is to induce mutation in guava plants through seed irradiation. For this purpose, seeds of two guava strains (Gola and Surahi) were irradiated from NIAB with different radiation frequencies (0 Gy, 100 Gy, 150 Gy, 200 Gy, 250 Gy, 300 Gy). The experiment was laid out under CRD design with factorial arrangements. The experiment was conducted during the spring season (February) of 2020. Twenty five seeds per treatment per variety were sown in germination trays replicated thrice. After one month of sowing germination starts in control treatment. The data is given as under:

Table 3: Attributes of irradiated seeds of Guava

| Treatments | Germination %age | Plant Height (cm) | No. of leaves/ plant | Leaf Length (cm) | Leaf Width (cm) |
|-------------------------|------------------|-------------------|----------------------|------------------|-----------------|
| T ₀ = 0 Gy | 37 | 13 | 8 | | |
| T ₁ = 100 Gy | 8 | 7.6 | 4 | | |

| | | | | | |
|-------------------------|---|-----|----|----|----|
| T ₂ = 150 Gy | 5 | 5.9 | 3 | | |
| T ₃ = 200 Gy | 0 | -- | -- | -- | -- |
| T ₄ = 250 Gy | 0 | -- | -- | -- | -- |
| T ₅ =300 Gy | 0 | -- | -- | -- | -- |

The experiment will be repeated in autumn of this year and the results will be given later.

6. Evaluation of different strains of Seedless Kinnow (*Citrus reticulata Balanco*) under Faisalabad climatic conditions

Citrus is one of the most important fruit crop being cultivated throughout the world and it is the No. 1 fruit crop of Pakistan. However, a large number of seeds present in the fruit are less likable from export point of view. Seedlessness has always been a striking idea for the pomologists. Selection is an easy and reliable tool for fruit breeding. For this purpose 11 strains of ‘Kinnow’ mandarin were selected from various areas of Punjab (Fig. 11), that were believed to be seedless or zero seeded. Given below are results of previous year (2019) that revealed that maximum plant height (8.5 ft) and plant canopy (66.40 ft²) were possessed by the plants of T₂ (Selection from ShujatWarriach); whereas maximum stem girth (18 inches) were shown by T₁₀ (selection from sultan farm Vehari) (Table.4). Maximum leaf area was recorded from T₁₁ (52.58 cm²) and number of fruits were found in T₅ (Selection from Shujjat Warraich) (Table 4). The data regarding fruit quality parameters are mentioned in Table 5 which was taken after harvesting of fruits.

Table 4: Vegetative attributes of Seedless Kinnow (*Citrus reticulata Blanco*) (2019)

| Strains/ Selection | Treatments | Plant height (ft) | Plant Canopy (ft ²) | Stem girth (inches) | Leaf Area (cm ²) | No. of fruits/ plant |
|------------------------|------------|-------------------|---------------------------------|---------------------|------------------------------|----------------------|
| R9P2 (ShujatWarriach) | T1 | 7.5 | 53.9 | 12.0 | 32.0 | 12.5 |
| R3P5 (ShujatWarriach) | T2 | 8.5 | 66.4 | 14.4 | 34.4 | 13.0 |
| R1P3(ShujatWarraich) | T3 | 6.5 | 59.2 | 13.2 | 24.9 | 14.3 |
| R1P4 (ShujattWarraich) | T4 | 6.5 | 31.6 | 12.0 | 26.5 | 16.6 |
| R4P3 (ShujattWarraich) | T5 | 6.7 | 54.0 | 14.4 | 39.1 | 16.8 |
| AT (AsadTiwana) | T6 | 7.0 | 37.2 | 12.0 | 41.9 | 6.7 |
| AT (AsadTiwana) | T7 | 7.5 | 54.6 | 14.4 | 35.0 | 5.0 |

| | | | | | | |
|---------------------------|-----|-----|------|-------------|-------------|------|
| AT (AsadTiwana) | T8 | 6.8 | 57.7 | 15.6 | 33.0 | 7.0 |
| L1P1 (Sultan farm Vehari) | T9 | 6.5 | 61.5 | 14.4 | 42.8 | 15.5 |
| L3P2 (Sultan farm Vehari) | T10 | 6.5 | 49.4 | 18.0 | 26.9 | 15.0 |
| L4B4 (Sundar farm) | T11 | 6.7 | 42.9 | 14.4 | 52.5 | 15.7 |

Table 5: Fruit Quality attributes of Seedless Kinnow strains (*Citrus reticulata* Blanco (2019-20))

| Strains/ selection | Average number of seeds/fruit | Average fruit size (cm ²) | Average fruit weight (g) | TSS (Brix°) | Acidity (%) | TSS: Acid |
|---------------------------|-------------------------------|---------------------------------------|--------------------------|-------------|-------------|-----------|
| R9P2 (ShujatWarriach) | 0-1 | 37.0 | 159.8 | 11 | 0.89 | 12.3 |
| R3P5 (ShujatWarriach) | 0 | 38.6 | 163.2 | 11.2 | 0.89 | 12.5 |
| R1P3 (ShujatWarrich) | 0 | 51.6 | 222.7 | 11.5 | 0.64 | 17.9 |
| R1P4 (ShujatWarrich) | 0 | 54.5 | 178.5 | 11.6 | 0.89 | 13.0 |
| R4P3 (ShujatWarrich) | 0-2 | 42.3 | 144.5 | 10.8 | 0.76 | 14.2 |
| Asad Tiwana farm | 0-2 | 50.2 | 228.4 | 11 | 1.28 | 8.5 |
| Asad Tiwana farm | 0 | 39.4 | 139.0 | 11.5 | 1.10 | 10.4 |
| Asad Tiwana farm | 0 | 45.7 | 117.7 | 12 | 1.28 | 9.3 |
| L1P1(Sultan farm Vehari) | 0 | 45.0 | 167.3 | 11.6 | 0.89 | 13.0 |
| L3P2 (Sultan farm Vehari) | 0-2 | 56.3 | 114.3 | 9.2 | 0.70 | 13.1 |
| L4B4 (Sundar farm) | 0-2 | 48.5 | 132.9 | 11 | 0.70 | 15.7 |



6. Response of jamun (*Syzygium cumini*) to different asexual propagation techniques and propagation time

Jamun (*Syzygium cumini*) is considered as an important minor crop in Pakistan. An appropriate propagation technique is direly needed for its multiplication. The research work on vegetative propagation of this crop is rather scanty at present. Therefore, the present research

was performed to assess the effect of different dates and grafting method on the success and relative growth of Jamun.

The recorded data shows that maximum success percentage (73%) was obtained from T-grafting in the month of September while minimum (11%) success rate was recorded in cleft grafting performed in February. Maximum days (42) were taken by the scion to sprout in case of cleft grafting in the month of October and these values were recorded minimum in case of T-budding carried out in the month of March. Stem girth was noted maximum (3.375cm) in T-budding when performed in month of September which is at par with in month of October. In case of leaf number, maximum leaf number (14) was counted in sprouts of September that were T-grafted and lowest value on this ground was recorded for cleft grafting (5) for the month of March. Leaf area was noted maximum (134 cm²) in T-grafting in the month of September. Highest value (5.25) for number of shoots was measured in case of T-grafting when carried out in the month of March. The shoots attained maximum (22.24cm) length in 60 days in those plants budded through T-grafting in March, while, it was observed minimum (5.47cm) in cleft grafting in February. It may be deduced from gathered results that T-grafting is most appropriate technique for Jamun propagation and best time for its propagation is September. Complete data is presented in table 6.

Table 6: Response of jamun towards different propagation techniques

(a) Success%

| Treatments | Sep | Oct | Feb | Mar |
|-------------------|------------|------------|------------|------------|
| T-Budding | 18 | 24 | 23.25 | 20.5 |
| T- Grafting | 73 | 55.25 | 42.5 | 37.75 |
| Cleft Grafting | 15 | 12 | 11 | 11.25 |

(b) Days taken to sprout

| Treatments | Sep | Oct | Feb | Mar |
|-------------------|------------|------------|------------|------------|
| T-Budding | 30 | 22.25 | 24 | 20.75 |
| T- Grafting | 34.5 | 33.25 | 21.75 | 23.25 |
| T- Cleft Grafting | 39.75 | 42 | 29.25 | 33.75 |

(c) Shoot length after 60 days

| Treatments | Sep | Oct | Feb | Mar |
|-------------------|------------|------------|------------|------------|
| T-Budding | 9.875 | 10.35 | 7.15 | 15.16125 |
| T- Grafting | 15.475 | 15.175 | 13.025 | 22.24125 |
| T- Cleft Grafting | 6.5575 | 6.925 | 5.475 | 8.5725 |

(d) Stem Girth after 60 days

| Treatments | Sep | Oct | Feb | Mar |
|-------------------|------------|------------|------------|------------|
| T-Budding | 3.375 | 3.15 | 2.525 | 2.1 |
| T- Grafting | 3.05 | 3.075 | 2.975 | 3.075 |
| T- Cleft Grafting | 2.425 | 2.625 | 2.55 | 2.625 |

(e) No. of shoots

| Treatments | Sep | Oct | Feb | Mar |
|-------------------|------------|------------|------------|------------|
| T-Budding | 3.5 | 3 | 3.75 | 3.5 |
| T- Grafting | 6.5 | 4.25 | 5 | 5.25 |
| T- Cleft Grafting | 2.5 | 2.75 | 2.5 | 3 |

(f) No. of Leaves

| Treatments | Sep | Oct | Feb | Mar |
|-------------------|------------|------------|------------|------------|
| T-Budding | 10.5 | 6 | 7.125 | 6 |
| T- Grafting | 14 | 9.25 | 12 | 10.25 |
| T- Cleft Grafting | 7.5 | 4.75 | 5.5 | 5.25 |

(g) Leaf area (cm²)

| Treatments | Sep | Oct | Feb | Mar |
|-------------------|------------|------------|------------|------------|
| T-Budding | 79 | 100.625 | 95.3 | 104.1 |
| T- Grafting | 134.25 | 123.475 | 98 | 119 |
| T- Cleft Grafting | 103 | 91.1125 | 115.5 | 99.81 |

7. Collection and maintenance of jamun germplasm

An experiment was conducted on the survey and collection of different Jamun strains locally available in Punjab. During fruiting seasons, different sites were surveyed and jamun of elite characteristics were collected and mother plants were tagged. The bud wood was collected and grafted during August-September. Plants of four strains were prepared asexually and transplanted in the orchard. Their data regarding survival and vegetative growth is in Table 7.

During 2019 two more selections were collected after survey. Morphological and biochemical characteristics of these two strains are given in Table 8.

Table 7. Survival %age and vegetative data of selected strains

| Treatments | Survival %age | Plant height (cm) | No. of shoots/plant | Leaf length (cm) | Leaf width (cm) | Leaf Area (cm ²) |
|-----------------------|---------------|-------------------|---------------------|------------------|-----------------|------------------------------|
| T ₁ (JS-1) | 100.00 | 57.2 | 4.6 | 13.1 | 4.94 | 64.7 |
| T ₂ (JS-2) | 100.00 | 29.8 | 3.3 | 12.2 | 4.90 | 60.1 |
| T ₃ (JS-3) | 100.00 | 63.1 | 4.1 | 11.4 | 4.37 | 50.1 |
| T ₄ (JS-4) | 100.00 | 67.4 | 3.4 | 11.4 | 5.08 | 58.2 |

Table 8. Morphological characteristics of selected strains

| Characteristics | JS-5 | JS-6 |
|----------------------------------|-----------------|-----------------|
| Shape of fruit | Oval | Oblong |
| Color of fruit | Purple | Purple |
| Color of arils | Whitish purple | Whitish purple |
| Size of fruit | Medium to large | Medium to large |
| Taste | Sweet and tart | Sweet and tart |
| Fruit firmness (kg) | 1.113 | 0.93 |
| Length of fruit (mm) | 32.90 | 29.58 |
| Width of fruit (mm) | 22.74 | 21.525 |
| Size of Fruit (mm ²) | 748.15 | |
| Weight of fruit (g) | 12.5 | 9.5 |
| Length of seed (mm) | 23.71 | Aborted seed |

| | | |
|--------------------------------------|--------|--------------|
| Width of seed (mm) | 10.31 | Aborted seed |
| Size of seed (mm²) | 242.08 | Aborted seed |
| TSS % | 16.6 | 15.225 |
| TA% | 0.835 | 0.925 |
| Vitamin C (mg/100 g) | 34.5 | 52.25 |

8. Standardization of IBA concentration in relation to planting time for rooting of jamun semi-hard wood cuttings

The experiment was initiated to find suitable dose of IBA for rooting of Jamun cuttings. Three doses of IBA i.e. 2000 ppm, 4000 ppm and 6000 were used in RCBD design. There were four replications. The treated cuttings were planted in low plastic tunnels to maintain 80 to 85% humidity and relative high temperature. Data collected are presented in following table 9.

Table 9: Performance of Jamun softwood cuttings at various levels of IBA

(a) Success (%)

| Treatments | Aug | Sep | Feb | Mar |
|-------------------------------|------------|------------|------------|---------------|
| T ₀ (Control) | 35.50c | 30.50d | 37.50c | 42.50bc |
| T ₁ (IBA 2000 ppm) | 38.00c | 33.00c | 27.50e | 47.50b |
| T ₂ (IBA 4000 ppm) | 54.50b | 49.50b | 44.23bc | 66.00a |
| T ₃ (IBA 6000 ppm) | 47.50b | 42.50b | 41.00bc | 59.50b |

(b) Survival (%)

| Treatments | Aug | Sept | Feb | Mar |
|-------------------------------|------------|---------------|------------|------------|
| T ₀ (Control) | 10.25f | 14.25e | 7.00g | 3.75h |
| T ₁ (IBA 2000 ppm) | 27.50c | 31.50c | 10.00f | 8.75g |
| T ₂ (IBA 4000 ppm) | 44.25b | 56.50a | 20.25d | 17.00de |
| T ₃ (IBA 6000 ppm) | 41.00bc | 47.50b | 15.50e | 11.50f |

(c) Shoot Length (cm)

| Treatments | Aug | Sept | Feb | Mar |
|-------------------------------|------------|-------------|------------|------------|
| T ₀ (Control) | 6.30d | 7.30cd | 5.32e | 6.33d |
| T ₁ (IBA 2000 ppm) | 8.05c | 9.05b | 5.68 | 6.55 |
| T ₂ (IBA 4000 ppm) | 10.48ab | 11.48a | 10.50ab | 9.00b |
| T ₃ (IBA 6000 ppm) | 8.78bc | 9.78b | 6.70d | 6.55d |

(d) No of leaves (Number)

| Treatments | Aug | Sep | Feb | Mar |
|-------------------------------|------------|--------------|------------|------------|
| T ₀ (Control) | 4.00d | 4.00d | 3.00ef | 2.50f |
| T ₁ (IBA 2000 ppm) | 8.00b | 8.25b | 4.00d | 3.25e |
| T ₂ (IBA 4000 ppm) | 8.50b | 9.00a | 5.75c | 5.25c |
| T ₃ (IBA 6000 ppm) | 5.50c | 5.75c | 4.25d | 5.00cd |

(e) Leaf Area (cm²)

| Treatments | Aug | Sept | Feb | Mar |
|-------------------------------|------------|-------------|---------------|------------|
| T ₀ (Control) | 21.00e | 21.00e | 28.00d | 22.00e |
| T ₁ (IBA 2000 ppm) | 33.50c | 31.75d | 40.00b | 33.75c |
| T ₂ (IBA 4000 ppm) | 40.00b | 41.00b | 48.75a | 43.50b |
| T ₃ (IBA 6000 ppm) | 36.00c | 34.75c | 44.25b | 39.25bc |

(f) Length of primary roots (cm)

| Treatments | Aug | Sep | Feb | Mar |
|-------------------------------|------------|---------------|------------|------------|
| T ₀ (Control) | 7.25e | 8.00e | 3.25g | 5.00g |
| T ₁ (IBA 2000 ppm) | 10.25d | 11.00d | 8.00e | 9.50e |
| T ₂ (IBA 4000 ppm) | 16.25b | 17.50a | 10.50d | 12.25d |
| T ₃ (IBA 6000 ppm) | 12.25c | 13.00c | 7.25f | 10.00d |

(g) Length of secondary roots (cm)

| Treatments | Aug | Sept | Feb | Mar |
|-------------------------------|------------|---------------|------------|------------|
| T ₀ (Control) | 7.25e | 9.50e | 4.50f | 5.25f |
| T ₁ (IBA 2000 ppm) | 9.75e | 12.00c | 7.00e | 7.75e |
| T ₂ (IBA 4000 ppm) | 14.50b | 17.75a | 11.75c | 12.50c |
| T ₃ (IBA 6000 ppm) | 11.50d | 14.25b | 9.25e | 9.50e |

(h) Root Volume (cm³)

| Treatments | Aug | Sept | Feb | Mar |
|-------------------------------|--------------|-------------|------------|------------|
| T ₀ (Control) | 3.63 | 2.80 | 2.13 | 2.83 |
| T ₁ (IBA 2000 ppm) | 4.70 | 4.33 | 3.68 | 3.85 |
| T ₂ (IBA 4000 ppm) | 6.53a | 5.83b | 5.15b | 5.40b |
| T ₃ (IBA 6000 ppm) | 6.00a | 5.18b | 4.65 | 4.75 |

Recorded data showed maximum success percentage (66%) was recorded in plants treated with IBA @4000 ppm during the month of march. Survival (56.50%) percentage and branch length 11.48 cm was found maximum in cuttings with IBA @ 4000 ppm during the month of September. No of leaves (9), primary roots (17.50), secondary roots 17.75 and root volume (6.53), were recorded higher during the month of September when treated with 4000 ppm IBA. Whereas leaf area was observed maximum (48.75) in February.

9. Hybridization of germplasm for development of new varieties of Pomegranate

The experiment was started with the aim to develop a new line of pomegranate having desired characteristics. For the purpose, four different crosses were made. The details are given below:

| | | |
|----------------|---|-----------------|
| T ₁ | = | Sandhura × PS-1 |
| T ₂ | = | PS-1 × Sandhura |
| T ₃ | = | Sandhura × PS-2 |
| T ₄ | = | PS-2 × Sandhura |

Table 10: Crossing of various strains of pomegranate for variety development

| Treat-ment | Cross | Crossed flower | Fruit set % | Fruit set | Fruit survival | Fruit survival % | No. of arils | No. of seeds germinated | Germination % |
|----------------|----------------|----------------|-------------|-----------|----------------|------------------|--------------|-------------------------|---------------|
| T ₁ | Sandura X PS-1 | 45 | 6.6 | 3 | 1 | 33.75 | 1267 | 340 | 34.5 |
| T ₂ | PS-1 X Sandura | 45 | 8.9 | 4 | 1 | 25 | 1377 | 450 | 56.6 |
| T ₃ | Sandura X PS-2 | 45 | 13 | 6 | 0 | 0 | 786 | 357 | 45.6 |
| T ₄ | PS-2 X Sandura | 45 | 13 | 6 | 3 | 50 | 1099 | 456 | 65.6 |

The plants will be shifted to main field and data will be recorded.

10. Efficacy of various chemicals to control bacterial blight in pomgranate (*punica granatum*).

This trial was conducted to control the bacterial blight of Pomegranate through various chemicals. Experiment was laid out under Randomized complete Block Design (RCBD) with three replications. Five treatments were applied i.e. T₀= Control, T₁= Bordeaux mixture@ (1:1:100 kg), T₂= Kocide @ 2.5g/L, T₃= Flare @ 1g/L and T₄= Thrill @ 2g/L. Data were collected regarding following parameters i.e Disease incidence (%), Fruit Cracking (%), Fruit length (mm), Fruit width (mm), Fruit weight (gm) and TSS (°Brix).Data is given below;

Table 11: Effect of various chemical treatments on blight induced pomegranate fruit cracking

| Treatments | Diseases incidence (%) | Fruit Cracking (%) | Fruit Length (mm) | Fruit width (mm) | Fruit Weight (gm) | TSS (°Brix) |
|--|------------------------|--------------------|-------------------|------------------|-------------------|-------------|
| T ₀ = Control | 65.3 a | 42.3 a | 45.1 d | 47.3 d | 63.6 d | 13 b |
| T ₁ = Bordeaux mixture @ (1:1:100 kg) | 45.7 d | 34.6 d | 52.4 a | 53.6 a | 76.7 b | 16.6 a |
| T ₂ = Kocide@2.5g/L | 48.3 c | 37.7 c | 47.2 c | 50.1 c | 75.1 c | 15.3 c |
| T ₃ = Flare @ 1g/L | 42.2 e | 30.1 e | 47.5 b | 52.9 b | 80.2 a | 15 d |
| T ₄ = Thrill @ 2g/L | 52.7 b | 40.5 b | 44.2 e | 46.5 e | 57.8 e | 13.6 E |

11. Performance of different grape varieties under climatic conditions of Faisalabad

Objective of the research trail was to select the most suitable varieties of grapes under the Agro-Climatic conditions of Faisalabad. Experiment was laid out according to Randomized Complete Block design. This design had eight treatments with four replications having one plant in each treatment. Total numbers of plants were 32. Eight varieties of grapes were planted in field.

Table 12: Performance of different grape varieties under climatic conditions of Faisalabad

| Variety | Bunch Length (cm) | Bunch Weight (g) | Berry Size | | | Number of Berries | TSS |
|----------------|-------------------|------------------|-------------|------------|-------------------------------|-------------------|--------|
| | | | Length (mm) | Width (mm) | Berry Size (mm ²) | | |
| White Seedless | 22.675 | 339 | 13.185 | 13.2275 | 26.41 | 293 | 14.325 |
| Perlette | 20.4 | 371.5 | 13.2275 | 13.565 | 26.79 | 300 | 17.775 |
| Bedana | 11.8 | 152.95 | 17.6725 | 14.605 | 32.28 | 54 | 14.875 |
| Black Seedless | 12.475 | 110.5 | 16.205 | 16.285 | 32.49 | 59.75 | 14.1 |
| Haita | 18.15 | 189.25 | 13.1225 | 11.4725 | 24.50 | 207 | 19.45 |
| Flame Seedless | 17.875 | 177 | 11.6525 | 9.3325 | 21.00 | 270 | 17.475 |
| Kings Rubby | 9.5 | 87 | 17.505 | 15.565 | 33.07 | 41.75 | 15.675 |
| Cardinal | 19.25 | 370.75 | 13.2925 | 12.44 | 25.73 | 370 | 14.675 |

Data showed that maximum bunch length (22.67 cm), bunch weight (371.5 g) and berry size (33.07 mm²) was recorded in white seedless, Perlette and Kings Ruby respectively, while minimum (9.5 cm) bunch length and bunch weight (87 g) was in Kings Ruby and berry size (21 mm²) in Flame Seedless. Whereas, in accordance to number of berries per bunch Perlette had maximum numbers (300) while Kings Rubby had minimum numbers (41.75). Perlette was most Ssweetest variety and had highest TSS (17.77 %) while Black Seedless had minimum TSS (14.1 %) as depicted in table 12.



Fig.12: Best performing grapes varieties under climatic conditions of Faisalabad

12. Standardization of blanching time on different varieties of dates for making dry dates (Chohara)

This trial was conducted to find out suitable blanching duration for making dry dates (chohara). Fruits at Doka (Khalal) stage was harvested, cleaned and blanched in boiling water (100 °C) for 10, 15, 20 and 30 minutes followed by placing in Electric Hot Air Dryer. There were four treatments and three replication. Complete randomized design (CRD) was applied to compare the treatment difference. Data recorded regarding different parameters were as follows:

Table 13: Effect of blanching time on quality attributes of dry dates

| Parameters | T₁ (10 min.) | T₂ (15 min.) | T₃ (20 min.) | T₄ (30 min.) |
|-------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|
| Fruit length (mm) | 38.1c | 38.5b | 39.6b | 39.9a |
| Fruit diameter (mm) | 19.2a | 19.0ab | 18.6b | 18.5b |
| Fruit size (mm ²) | 731.5c | 731.6b | 736.6b | 738.5a |
| Fruit weight (g) | 7.2c | 7.6b | 8.2ab | 8.5a |
| TSS (%) | 14.2a | 13.7ab | 13.6ab | 12.3b |

| | | | | |
|-----------------------|-------|--------|---------|-------|
| Fruit firmness (kg) | 5.90a | 5.70b | 5.30 bc | 5.20c |
| Moisture contents (%) | 10.2b | 10.5ab | 11.4ab | 11.7a |

According to results maximum fruit length, fruit size, fruit weight and moisture contents were recorded in T₄ (blanching at 30 min.) while maximum TSS, firmness and fruit diameter was noted in T₁ (blanching at 10 min). T₃ (blanching at 20 min) found best having moderate results in terms of all parameters.

13. Development of chance seedling varieties of date palm from exotic cultivars at agro-climatic conditions of Faisalabad

The present study was executed to determine the performance of different date palm varieties at agro-climatic conditions at Faisalabad. The research was designed according to Randomized Completely Block Design (RCBD) with eighteen treatments having four replicates. Seeds of twenty date palm varieties were sown in sterilized growing media. The results showed that Amber variety of date palm showed better results regarding different physical attribute like highest survival percentage (100%), plant height (126.5 cm), stem girth (38.3 cm) and leaf area (116.1 cm²). Another variety Mabroon showed distinguished results pertaining to No. of leaflets/frond (73.0) and No of suckers (5.5). Consequently, it is concluded that Amber and Mabroon was proved best in the studied characteristic among all the considered exotic date palm germplasm.

Survival (%)

The range of survival percentage lies between 94-100% and the average survival percentage was 97%. The highest germination (100%) was found in the Amber variety while minimum (76.0%) survival % was found in Dakki seeds. Table-14 revealed that there is less statistically significant ($p > 0.05$) relationships were detected between varieties and survival percentage.

Plant Height (cm)

Maximum plant height was measured in Amber seedlings (126.5 cm) followed by Amber and Ajwa exhibited maximum height 126.3cm and 116.5cm respectively. Minimum plant height was

observed in Mabroon seedlings (68.0 cm). Data of plant height of different date palm seedlings varied statistically.

Stem Girth (cm):

There was a significant ($p < 0.05$) variation in stem girth values for the studied varieties. The table 2 depicted that the stem girth values increases significantly. Amber seedlings are distinguished by the highest stem girth value (38.3 cm) following as Saugi and Khudrawi depicted highest range 34.0 cm and 33.3 cm respectively. Although lowest stem girth was recorded in variety Karbla (26.5cm) and Ajwa (28.0cm).

No. of Fronds:

The data indicated that seedlings showed statistically non-significant ($p > 0.05$) results. Maximum No. of fronds were observed in variety Amber seedlings with 11.5 while least no of fronds were noted in Ajwa (5.3) following as Saugi and Rubai varieties showed minimum no of fronds 6.3 and 6.5 respectively.

No. of Leaflets/frond:

The data regarding no of leaflets/frond revealed significant ($p < 0.05$) differences within all exotic varieties as cited in table 14. The data exhibited that higher no of leaflets/frond were noted in variety Mabroon (73.0) afterwards Amber and Ringro showed 71.2 and 71.0 No. of leaflets/fronds respectively. While lowest no of leaflets/frond were noted in kalma exotic seedling (52.8).

Leaf Area (cm²):

Leaf area significantly ($p < 0.05$) differed between exotic seedlings. The results presented maximum leaf area (116.1 cm²) in Amber variety. While the minimum leaf area was indicated 92.8 cm² in Pamazo seedlings.

No. of Suckers evolved:

Analysis of data revealed that there is statistically significant relationship found in exotic varieties and number of suckers evolved. Maximum number of suckers were evolved in Mabroon

variety (5.5) following as Amber and Shrifia grown the suckers (4.8) while the least (1.5) number of suckers were grown in Ringro and Saugi.

Conclusion:

Consequently, it is concluded that Amber and Mabroon was proved best in the studied characteristic like plant height, survival percentage, No of fronds, leaf area and No. of suckers among all the considered exotic date palm germplasm. From this experimental study it is clear that exotic varieties of date palm can be successfully grown in agro-climatic conditions of Faisalabad, Pakistan with the equal success as in gulf countries.

Table14: Vegetative parameters of chance seedlings of Date palm varieties

| Name of variety | Survival %age | Plant height (cm) | Stem girth (cm) | No. of fronds |
|-----------------|---------------|-------------------|-----------------|---------------|
| Ajwa | 95.0a | 116.5a | 28.0de | 5.3c |
| Rubai | 99.0a | 96.5fgh | 32.3abc | 6.5bc |
| Mabroon | 98.0a | 68.0 l | 30.0cde | 8.0abc |
| Amber | 95.0a | 106.3bcd | 34.3a | 7.5abc |
| Kalma | 97.0a | 94.8fgh | 29.5cde | 8.5ab |
| Tamur-ul-Wahdi | 95.0a | 86.8jk | 29.5cde | 7.8abc |
| Khudrawi | 99.0a | 111.5ab | 32.5abc | 9.0ab |
| Karbla | 99.0a | 87.8ijk | 26.5e | 8.5ab |
| Biarum | 97.0a | 111.8ab | 30.0cde | 10.3a |
| Pamazo | 99.0a | 103.3cde | 30.3bcde | 8.8ab |
| Sharifa | 95.0a | 97.0efg | 32.5abc | 7.8abc |
| Ringro | 100.0a | 100.3def | 33.0abc | 6.8bc |
| DegletNour | 98.0a | 108.0bc | 32.0abc | 7.3bc |
| Baiza | 94.5a | 90.3hijk | 31.3abcd | 7.0bc |
| Saugi | 95.0a | 87.5ijk | 34.0ab | 6.3bc |
| Zaidhi | 98.0a | 92.0ghij | 32.0abc | 7.0bc |
| Dakki | 96.0a | 93.5ghi | 30.0cde | 8.3ab |
| Hallawi | 97.0a | 85.5k | 33.3abc | 8.5ab |
| Khudrawi | 98.0a | 104.0cd | 33.3abc | 7.3bc |

| | | | | |
|---|-------|---------|----------|-------|
| Zaidhi | 95.0a | 94.3fgh | 31.5abcd | 6.8bc |
| Means followed by the same letters are not significantly different from each other at 5% significance level | | | | |

Maximum plant height was measured in Ajwa seedlings (116.5 cm) afterwards Biarum and Khudrawi showed maximum height 111.8cm and 111.5cm respectively. Minimum plant height was observed in Mabroon seedlings (68.0 cm). Data of plant height of different date palm seedlings varied statistically.

There was a significant ($p < 0.05$) variation in stem girth values for the studied varieties. The table 1 depicted that the stem girth values significantly increase. Amber seedlings are distinguished by the highest stem girth value (34.3 cm) following as Saugi and Khudrawi depicted highest range 34.0 cm and 33.3 cm respectively. Whereas minimum stem girth was recorded in variety Karbla (26.5cm) and Ajwa (28.0cm). Indeed these phenotypic variation reveals a genomic variability however the influence of climate was excluded.

The data in Table 14 indicated that seedlings showed statistically non-significant ($p > 0.05$) results. Maximum no. of fronds were observed in variety Biarum seedlings with 10.3 while least no of fronds were noted in Ajwa (5.3) following as Saugi and Rubai varieties showed minimum no of fronds 6.3 and 6.5 respectively.

14. Standardization of suitable temperature for processing/ dehydration of dates

There are two motivations for turning dates into dehydrated dates. One is to capitalize on the world's largest dry date market next door, India, and the other one is to secure dates by processing it fast before the monsoon rains and to get it into the markets as fast as possible. So, this experiment is conducted to standardize the temperature to prepare the dehydrated soft dates. Four treatments were applied T_1 (control) = Sun drying, $T_2 = 52 \pm 1^\circ\text{C}$, $T_3 = 56 \pm 1^\circ\text{C}$, $T_4 = 60 \pm 1^\circ\text{C}$ and replicated 3 times. Results are following:

Dhakki:

Fruit maximum fruit length (39.4mm) was observed at temperature 52°C whereas, minimum length of fruit (38.4mm) was observed at 60°C . Similarly, highest fruit diameter (20.9mm) in Dhakki fruit was observed at 52°C as well as minimum (20.4mm) observed at control treatment. Similarly, maximum fruit size (817mm^2) was observed at 52°C . While maximum fruit weight was

(11.2 g) and moisture contents were (20.4%) observed at control treatment. While minimum fruit weight (10.2 g) and moisture contents (15.1%) were noted at 60°C. Moreover, highest TSS% (43.5) and firmness (0.42) was recorded while minimum TSS% (43) and fruit firmness was noted (0.39) in T₃ (56°C) and in control respectively.

Khudrawi:

In Khudrawi maximum fruit length (29.5mm) was observed at temperature 52°C whereas, minimum length of fruit (28.3mm) was observed at 60°C. Similarly, highest fruit diameter (19.7) while as minimum diameter of fruit (18.5mm) was observed at 60°C. Similarly, maximum fruit size (578mm²) was noted in 52°C and minimum diameter was recorded in 18.5mm² at 60°C. Moreover, highest moisture contents was noted in control while minimum was observed at 60°C. Maximum TSS and firmness (40%, 0.21kg) was found at 60°C and minimum (37.2%, 0.21kg) was noted at control treatment.

Table 15: Comparison of date varieties at different temperatures

| Parameters | Variety | T ₀ (control) | T ₁ (52±2°C) | T ₂ (56±2°C) | T ₃ (60±2°C) |
|-------------------------------|----------|--------------------------|----------------------------|----------------------------|----------------------------|
| Fruit Length (mm) | Dhakki | 39.4 a | 39.1 b | 38.7 c | 38.4 c |
| | Khudrawi | 29.1 c | 29.5 a | 29.2 b | 28.3 d |
| Fruit diameter (mm) | Dhakki | 20.4 c | 20.9 a | 20.7 b | 20.5 c |
| | Khudrawi | 19.7 a | 19.6 b | 19.0 c | 18.5 d |
| Fruit size (mm ²) | Dhakki | 803.76b | 817.19 a | 801.09 c | 787.2 d |
| | Khudrawi | 573.27 b | 578.2 a | 554.8 c | 523.55 d |
| Fruit wt. (g) | Dhakki | 11.2 a | 10.8 b | 10.4 c | 10.2 c |
| | Khudrawi | 8.2 a | 8.1 b | 8.0 c | 7.9 d |
| Moisture contents (%) | Dhakki | 21.4 a | 17.3 b | 17.0 c | 15.1 d |
| | Khudrawi | 22.7 a | 19.1 b | 17.3 c | 16.8 d |
| TSS (%) | Dhakki | 41.3 d | 43.1 b | 43.0 c | 43.5 a |
| | Khudrawi | 37.2 d | 38.7 c | 38.9 b | 40.0 a |
| Firmness (kg) | Dhakki | 0.39 c | 0.40 b | 0.42 a | 0.42 a |
| | Khudrawi | 0.21 d | 0.24 c | 0.26 b | 0.28 a |



Fig.13: Date fruit after dehydration

15. Adoptability of various fig strains under climatic conditions of Faisalabad

This trial was conducted to check the performance of different strains of Fig in climatology of Faisalabad. Experiment was laid out according to Randomized Complete Block Design (RCBD). Six strains of fig were collected i-e Green Fig, Fig selection-1 (Ly), Fig selection-2 (AARI), Fig selection-3 (black) and Fig selection-4 (brown) and Fig selection-5 (RYK) with four replications. Data were collected regarding vegetative parameters i-e survival %, plant height, no of branches, no of leaves/branch, length of leaf, width of leaf and size of leaf as well as fruit parameters i-e number of fruits/branch, length of fruit, width of fruit, size of fruit, weight of fruit and TSS. Data is given in the following tables:

Table 16 (a): Vegetative parameters of different strains of fig

| Variety/ strain | Survival %age | Plant height (ft.) | No. of shoots/ plant | No. of leaves/ shoot |
|------------------------------|----------------------|---------------------------|-----------------------------|-----------------------------|
| T ₁ (Green Fig) | 13 | 6.2 | 10.4 | 15 |
| T ₂ (FS-1: LY) | 87.5 | 8.1 | 20.4 | 22.6 |
| T ₃ (FS-2 AARI) | 87.5 | 8.7 | 21.7 | 21.8 |
| T ₄ (FS-3: Black) | 62.5 | 8.8 | 22.6 | 25.6 |
| T ₅ (FS-4: Brown) | 37.5 | 7.8 | 20.0 | 20.8 |
| T ₆ (FS-5: RYK) | 100 | 9.3 | 25.7 | 25.0 |

Table 16 (b): Vegetative parameters of different strains of fig

| Variety/ strain | Leaf length (mm) | Leaf width (mm) | Leaf size (mm ²) | Stem diameter (cm) |
|------------------------------|------------------|-----------------|------------------------------|--------------------|
| T ₁ (Green Fig) | 106.3 | 89.5 | 9513.8 | 17.7 |
| T ₂ (FS-1: LY) | 108.5 | 92.3 | 10014.5 | 25.4 |
| T ₃ (FS-2 AARI) | 115.5 | 98.8 | 11,411.4 | 27.4 |
| T ₄ (FS-3: Black) | 100.0 | 75.8 | 7580.0 | 22.86 |
| T ₅ (FS-4: Brown) | 96.8 | 87.3 | 8450.6 | 22.86 |
| T ₆ (FS-5: RYK) | 114.8 | 96.8 | 11112.6 | 25.9 |

According to results maximum survival percentage (100%), plant height (9.3ft), number of shoots/plant (25.7) were noted in (FS-5: RYK) while maximum leaf size (11,411mm²) and stem diameter (27.4cm) was recorded in (FS-2 AARI). Minimum survival percentage (13%), plant height (6.2 ft), number of shoots/plant (10.4) and no of leaves/shoot (15) were recorded in (Green Fig).

Table 17 (a): Fruit quality parameters of different strains of fig

| Variety/ strain | No of fruits/plant | Fruit weight (gm) | Fruit size (mm ²) | Yield/plant (Kg) |
|------------------------------|--------------------|-------------------|-------------------------------|------------------|
| T ₁ (Green Fig) | 100 | 18.5 | 1181.1 | 1.9 |
| T ₂ (FS-1: LY) | 300 | 18.5 | 1124.7 | 5.5 |
| T ₃ (FS-2 AARI) | 289 | 17.3 | 916.6 | 4.9 |
| T ₄ (FS-3: Black) | 373 | 17.5 | 903.7 | 6.5 |
| T ₅ (FS-4: Brown) | 316 | 16.8 | 1070.6 | 5.3 |
| T ₆ (FS-5: RYK) | 390 | 19.5 | 1331.1 | 7.3 |

Table 17 (b): Fruit quality parameters of different strains of fig

| Variety/ strain | TSS % | Firmness (Kg) |
|------------------------------|-------|---------------|
| T ₁ (Green Fig) | 13.1 | 1.45 |
| T ₂ (FS-1: LY) | 14.4 | 1.22 |
| T ₃ (FS-2 AARI) | 14.0 | 1.26 |
| T ₄ (FS-3: Black) | 15.2 | 1.33 |

Data concerning fruit parameters shows that maximum fruit weight (19.5g), fruit size (1331.1mm²), and fruit yield (7.3kg) was recorded in (FS-5: RYK) while maximum firmness (1.45kg) was calculated in (Green Fig). According to above results (FS-5: RYK) performed better in climatology of Faisalabad as compared to other strains.



Fig.14: Whole and cross sectional view of green fig

16. Introduction of Olive cultivars under Faisalabad conditions

Olive is the fruit as well as oil crop presently gaining much attention of researchers. In this regard a field experiment is conducted with 5 Olive varieties named as Gamlick, Arbequina, Coronikie, BARI zaitoon I and BARI zaitoon II. Asexually propagated plants of these varieties were transplanted to field in square system during autumn season of 2016. Seven plants of each variety were transplanted with planting distance of 18 feet. Data regarding various vegetative attributes is given as under:-

Table 18: Morphological characteristics of Olive varieties

| Treatment | Plant height (cm) | No. of shoots per plant | Stem Girth (cm) | Leaf area (mm) ² |
|---------------------------------|-------------------|-------------------------|-----------------|-----------------------------|
| T ₁ =Arbequina | 112.4 | 189 | 21.0 | 714 |
| T ₂ =Gamlick | 103 | 156 | 25.8 | 510 |
| T ₃ =Coronikie | 134.5 | 204.6 | 26.9 | 587 |
| T ₄ =BARI zaitoon-I | 25.4 | 22.0 | 5.09 | 503 |
| T ₅ =BARI zaitoon-II | 35.7 | 16.0 | 4.7 | 659 |

17. Impact of plant growth regulators on growth and yield of Strawberry (cv. Chandler)

A field experiment was conducted at Horticultural Research Institute Faisalabad, to check the effect of plant growth regulators (PGRs) on growth and yield of strawberry. Seven treatments were applied under randomized complete block design (RCBD) with three replications. Runners were planted in the month of October-November. Some morphological and physicochemical traits were evaluated. It was observed that the maximum number of leaves (18.5%), root volume (9.1cm³) and TSS (8.3 °Brix) in T₂= GA₃ @50 ppm. On the other hand, highest leaf area (52.4 cm²), No. of flower (57.3) recorded in T₃= GA₃ @ 75 ppm. While maximum firmness was observed in 1.29 kg in T₆= NAA @ 60 ppm.

Table 19: Effect of various growth regulators on fruit quality of strawberry

| Treatments | No. of Leaves | Leaf Area (cm ²) | Root Volume (cm ³) | No. of Flower | No. of fruit | Firmness (kg) | TSS (°Brix) |
|---|---------------|------------------------------|--------------------------------|---------------|--------------|---------------|-------------|
| T ₀ =Control | 13.4 e | 40.5 d | 5.2 f | 30.5 d | 8.34 f | 0.25 g | 6.89 g |
| T ₁ = GA ₃ @ 25 ppm | 17.3c | 34 f | 6.1 d | 37.1 c | 30 d | 0.71 e | 7.13 e |
| T ₂ = GA ₃ @ 50 ppm | 18.5 b | 37.1 e | 9.1 a | 56.5 a | 71.4 b | 0.74 d | 8.3 a |
| T ₃ = GA ₃ @ 75 ppm | 20 a | 52.4 a | 8.5 b | 57.3 a | 79.3 a | 0.9 c | 7.05 f |
| T ₄ = NAA @ 20 ppm | 15.4 d | 31.2 g | 4 g | 26.1 e | 15.2 e | 1.12 b | 7.45 d |
| T ₅ = NAA @ 30 ppm | 17.4 c | 51.6 b | 5.7 e | 40.6 b | 40.4 c | 0.69 f | 7.57 c |
| T ₆ = NAA @ 60 ppm | 11.5 f | 46.5 c | 7.5 c | 24.4 f | 11.5 g | 1.29 a | 7.86 b |

Meterology of Faisalabad 2019-20

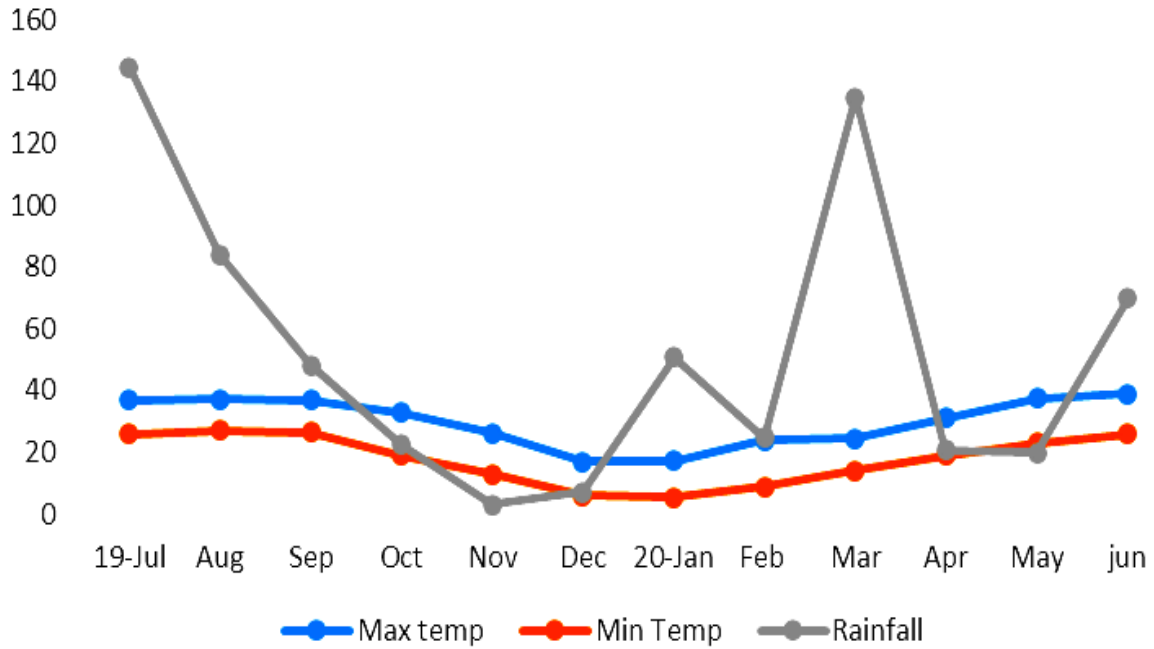


Fig 15: Metrology of Faisalabad during 2019-20

DATE PALM RESEARCH SUB-STATION, JHANG

This station was established in 1945 when Sardar Lal Bhadar Singh selected this area due to its feasible climate which is hot and dry and this site was easy to visit frequently for him. Commonly area favorable for cotton cultivation consider also good for date cultivation. In 1945 about 15000 suckers of different varieties were brought from Basra (Iraq) i.e. Hillawi, Zaidi, Shamran, Khudrawi, etc. along with male plants. Now the total area is 55 Acres including Research as well as Building area. Presently it is a Research Sub Station under Horticultural Research Institute, Faisalabad. Currently, main focus of the DPRSS is date palm varietal approval and acclimatization of high valued exotic varieties to Pakistani climate.

Objectives:

- Selection and acclimatization of local and exotic varieties of Date Palm
- To standardize advanced technology for date palm cultivation
- Experimentation on Date fruit
- To provide the pedigree plants to the farmers at subsidized rates
- To coordinate with other Research Organizations in Pakistan as well as Abroad
- To diagnose and analyze insect pest and Disease and devise control measures

18. Varietal performance of different exotic date palm cultivars under Central Punjab condition

The experiment was conducted to evaluate the most suitable cultivars under central Punjab condition. Nine varieties of date palms were studied for their growth yield and quality character and their adaptability under central Punjab. Data collected is presented in following table.

Table 20: Varietal performance of different exotic date palm cultivars under Central Punjab condition

| S.# | Variety | Plant height (cm) | No. of fronds | Fronds length (cm) | No. of pinnae | No. of suckers | No. of spathes |
|------------|----------------|--------------------------|----------------------|---------------------------|----------------------|-----------------------|-----------------------|
| 1. | Ajwa | 276.70 | 10.71 | 238.05 | 93.85 | 5.28 | 2.28 |
| 2. | Amber | 243.42 | 12.85 | 203.48 | 73.71 | 1.28 | 0.71 |
| 3. | Barhee | 255.85 | 10.42 | 226.15 | 89.28 | 2.14 | 0.85 |

| | | | | | | | |
|----|--------------|--------|--------------|---------------|-------|-------------|-------------|
| 4. | Khalas | 206.32 | 7.42 | 172.8 | 77.14 | 5.14 | 0.85 |
| 5. | Khudri | 194.07 | 9.42 | 164.28 | 70.85 | 8 | 3.28 |
| 6. | Nabut e saif | 235.85 | 7.71 | 206.71 | 60.28 | 1.71 | 0.57 |
| 7. | Sagai | 240.57 | 13.42 | 207.42 | 84.42 | 3.85 | 2.28 |
| 8. | Shishi | 221.71 | 11.42 | 189.14 | 76.14 | 8.14 | 0 |
| 9. | Sultana | 203.14 | 7.71 | 174.57 | 76.14 | 2.28 | 0.42 |

It is concluded that maximum plant height 276.70 cm was attained in Ajwa following by saagai (240.57cm). Maximum No of fronds 13.42 and frond length 207.42 cm was observed in Saagai While, maximum no of pinnae was noted in Ajwa. No. of suckers (8.14) in Shishi and no of spath (3.28) was maximum in Khudri cultivar. Maximum no of suckers in Shishi and maximum spath were in khudri were recorded.

3. Assessment of different exotic date palm cultivars under central Punjab condition

The trial was carried out to develop new varieties of Date Palm through chance seedling under Punjab Conditions. The vegetative parameters noted are as follow:-

Table 21: Assessment of different exotic date palm cultivars under central Punjab condition

| S. No. | Variety | Total Seeds | Germinated seeds | Germination %age | Height (cm) | No. of leaves |
|--------|---------|-------------|------------------|------------------|--------------|---------------|
| 1 | Ajwa | 150 | 150 | 100 | 41.6 | 5.5 |
| 2 | Amber | 150 | 147 | 98 | 42.41 | 5.3 |
| 3 | Barhee | 150 | 148 | 98.6 | 34.80 | 4.7 |
| 4 | Khalas | 150 | 145 | 96 | 33.49 | 4.2 |
| 5 | Medjool | 150 | 149 | 99 | 33.57 | 4.4 |

From the above table it is concluded that maximum germination percentage (100%) was calculated in Ajwa followed by Medjool (99%). Maximum Height 42.41 cm was noted in Amber while no of leaves 5.5 were observed maximum in Barhee seedlings.

19. Effects of thinning on fruit quality and yield of date palm (Dhakki)

The trail was conducted to improve the quality and yield of Date palm strains Dhakki The experiment was laid out by RCBD with four treatments. There were three replications with two plant per treatment. The treatments are as under:-

- T₀ = Control (No thinning)
- T₁ = Thinning 1/4 of total number of bunches
- T₂ = Thinning ¼ of total strands per bunch
- T₃ = 50% thinning of strand per bunch

These treatments were applied during the month of March (just after the one week of pollination). Data was collected in at fruit stage in July month.

Table 22: Effects of thinning on fruit quality and yield of date palm (Dhakki)

| Treatments | Spathes/ plant | Bunch Weight (Kg) | Weight of Fruit (g) | Yield/Plant (Kg) | TSS |
|----------------------|----------------|-------------------|---------------------|------------------|-------------|
| T₀ | 12 | 16.35 | 19.34 | 160.84 | 26.66 |
| T₁ | 10.5 | 20.3 | 19.7 | 171.54 | 25.3 |
| T₂ | 11.25 | 27.45 | 20.26 | 190.36 | 27.25 |
| T₃ | 12.74 | 26.6 | 20.4 | 182.16 | 27.7 |

From above table it is concluded that maximum spathes (**12.74**) per plant were noted in **T₃**. Maximum Bunch weight, fruit weigh and yield per plant were observed in **T₂**. While, Maximum TSS 27.7 was calculated in **T₃**.

HORTICULTURAL RESEARCH STATION, BAHAWALPUR

Horticultural Research Station Bahawalpur was established in 1982-83 under an ADP-Intensification of research on Horticultural Crops. Office & residential buildings were constructed and 25 acres of land was acquired from Agriculture Department for the Date palm germplasm collection and research under another ADP- Additional Facilities for Date Palm Research at Bahawalpur during 2002-03. A PARB funded project “Micropropagation of date palm through tissue culture” was started during 2010. Explant material (suckers) of different date varieties were provided to collaborating organization (NARC) for micropropagation of date palm. An ADP-Additional facilities for improvement fruit yield and quality of guava, pomegranate and date palm, was accomplished during 2014-16, to import high market value genotypes of date palm for evaluation and adaptability testing of new genotypes of date palm for acclimatization under the climatic conditions of the Punjab. A new ADP- Establishment of tissue culture Lab at HRS and provision of missing facilities at RARI Bahawalpur, was started during 2019 for micropropagation research on fruit plants.

Objectives:

- Systematic studies to develop production technology of fruit plant i.e. Date palm, Ber, Pomegranate and Guava.
- Selection of new strains from local and exotic plant material and to study their adaptability under local agro climatic conditions.
- To standardize the nutritional requirements of fruit i.e. Date palm, Ber, Pomegranate and Guava.
- To standardize GAP requirements of Date palm, Ber, Pomegranate and Guava.
- To develop true to type nursery plants of promising varieties through propagation for their delivery to the farmers.
- Capacity building of farmers for increasing the area and production of fruit in the region.

Experimental details:

20. Impact of climate regimes on production and quality of exotic Date palm (*Phoenix dactylifera*) germplasm

The southern part of Punjab province is considered best for date production, but fluctuating climatic conditions is the major hindrance in best quality production. Keeping in view the aforementioned fact, a research study has been designed to evaluate the impact of different climate regimes i.e., monsoon rains and abrupt high temperature on the production and quality of exotic date germplasm. High rains (96 mm) and high humidity (89%) during August, 2019

(Table 23) badly affected Khudri strain which had 50% fermented fruit, Amber strain attained maximum frond length (118 cm) and ranked 2nd in yield (80 kg.) in doka stage with return from dokas ((Rs.3600), maximum Tamar (70 kg.) & Chohara (60 kg.) and fetched maximum return in case of Tamar (Rs. 4550) and Chohara (Rs.4200) per plant respectively. Barhee strain had maximum yield (95 kg.) at doka stage with maximum return (Rs. 3800) from dokas and ranked 2nd in Tamar (65 kg.) & Chohara (57 kg.) and gave return from Tamar (Rs. 3250) and return from chohara (Rs. 3420) per plant respectively (Table 23). Heavy rains (103 mm) during March, 2020 (Fig.15) badly affected pollination process and caused less fruit setting in all exotic date palm strains, due to which very low yield is expected in coming harvesting season. Ajwa, Amber, Khalas and Barhee strains bear heavy fruit and tolerated monsoon rains. Khudri variety adversely affected by monsoon rains. Maximum fruiting was recorded in Amber under prevailing climate, followed by Barhee variety. The current result year revealed that Barhee could be the best alternative variety for Halawi in south Punjab region at doka stage. Amber and Ajwa on curing showed acceptable characteristics to be used as ‘Tamar’.

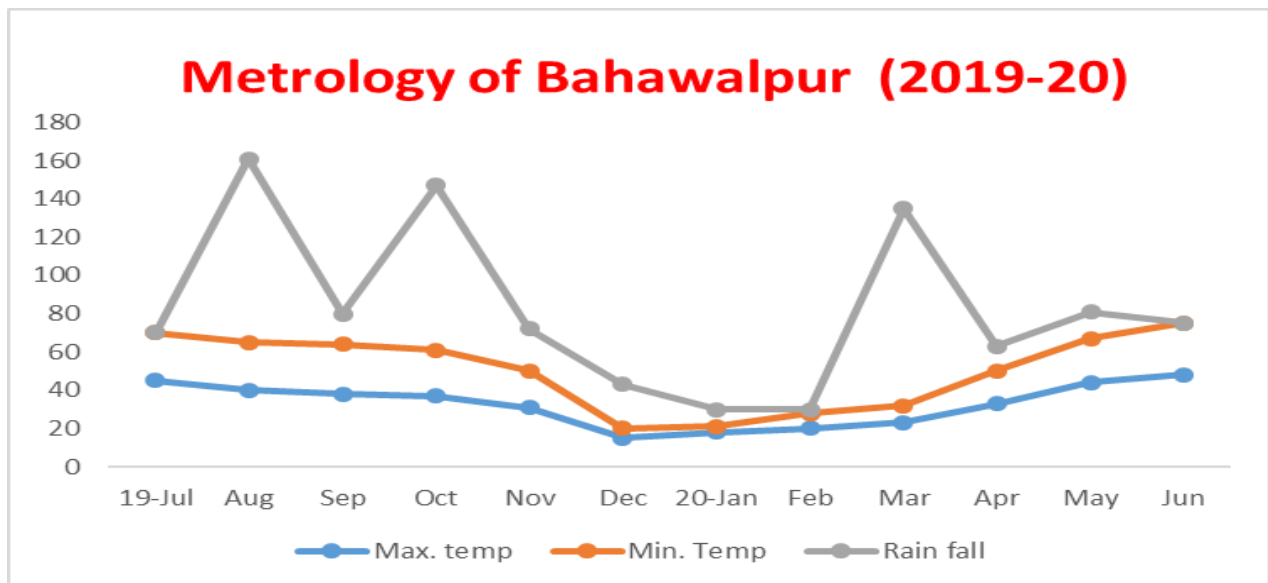


Fig.16: Metrological features of Bahawalpur city during July 2019- June 2020

Table 23: Various attributes of date palm varieties under climatic regimes of BWP

| S.# | Date Strains | Length of frond (cm) | Ferment fruit (%) | Doka yield/ plant (kg) | Return Rs. (Doka) | Tamar / plant (kg) | Chohara / plant (kg) | Return Rs. (Tamar) | Return Rs. (Chohara) |
|-----|--------------|----------------------|-------------------|------------------------|-------------------|--------------------|----------------------|--------------------|----------------------|
| 1 | Sultana | 98 | 30 | 35 | 1400 | 25 | 20 | 1500 | 1400 |
| 2 | Shishi | 110 | 30 | 45 | 1800 | 30 | 25 | 1800 | 1750 |
| 3 | Sugai | 102 | 35 | 70 | 2450 | 50 | 42 | 3000 | 2950 |
| 4 | Nabtul-Saif | 116 | 30 | 55 | 2200 | 38 | 33 | 2280 | 2310 |
| 5 | Khudri | 112 | 50 | 77 | 2310 | 47 | 40 | 2350 | 2400 |
| 6 | Khalas | 92 | 25 | 75 | 2250 | 45 | 38 | 2700 | 2660 |
| 7 | Barhee | 114 | 25 | 95 | 3800 | 65 | 57 | 3250 | 3420 |
| 8 | Amber | 118 | 30 | 80 | 3600 | 70 | 60 | 4550 | 4200 |
| 9 | Ajwa | 83 | 30 | 60 | 3000 | 42 | 37 | 2950 | 2590 |
| 10 | Medjoul | 50 | - | - | - | - | - | - | - |
| 11 | Raziz | 77 | - | - | - | - | - | - | - |
| 12 | Lulu | 70 | - | - | - | - | - | - | - |
| 13 | Nemeishi | 80 | - | - | - | - | - | - | - |
| 14 | Zamli | 75 | - | - | - | - | - | - | - |

**Fig. 17: Khudri a vulnerable strain of Date palm to rainfall**

21. Performance evaluation of exotic germplasm of Date palm at Bahawalpur

Acclimatization of exotic germplasm is the one of the quick method of variety development. Attempts are being made to import high market value date palm strains / varieties from other countries and to evaluate the performance of exotic germplasm of Date palm with respect to local climatic conditions and its economic value for the region. Fourteen exotic Date palm varieties viz Sultana, Shishi, Sugai, Nabt-ul-Saif, Khudri, Khalas, Barhee, Amber, Ajwa, Medjoul, Lulu, Nemeishi, Raziz and Zamli were planted at Horticultural Research Station Bahawalpur during March, 2016 and Sept-Oct., 2017. These plants are being tested for their performance under climatic conditions of southern part of the country. The results obtained on different parameters are tabulated in table 24. Plants of Nabt-ul-Saif variety attained maximum plant height (2.57m) and maximum frond length (2.48m), while Sugai has maximum number of fronds (38), while plants of Medjool variety showed minimum plant height (0.82 m) and number of fronds (14). Plants of Shishi variety attained maximum number of pinnae per frond (58), Barhee has maximum number of strands per spathe (32) and bore maximum number of fruit per strand (28), while plants of Medjool variety showed minimum frond length (0.70 m) and number of pinnae (Table 24). Amber (Fig. 17 a) has maximum fruit weight (23 g), fruit length (4.8cm), fruit breadth (2.8cm) and ranked 2nd in yield (80 kg / plant). Barhee led the all varieties with maximum yield (95 kg / plant) as given in Table 25. Some plants of Ajwa (Fig.17 b) variety bore more small fruit. Similarly Khudri variety also had very small low quality fruit. Both varieties need fruit thinning to make their fruit in acceptable size and quality.



Fig. 18 (a): A bunch of Amber variety



Fig. 18 (b): A bunch of Ajwa variety

Table 24: Vegetative attributes of different varieties of date palm

| Variety | Av. plant Height (m) | Av. Frond Length (m) | Av. No. of fronds | Av. No. of Pinnae / Frond | Av. No. of strands / spathe | Avg. No. of fruits / strand |
|--------------|----------------------|----------------------|-------------------|---------------------------|-----------------------------|-----------------------------|
| Ajwa | 2.10 | 1.52 | 33 | 50 | 16 | 20 |
| Amber | 2.25 | 1.71 | 32 | 54 | 19 | 15 |
| Barhee | 2.29 | 1.66 | 28 | 52 | 32 | 28 |
| Khalas | 2.02 | 1.64 | 30 | 47 | 20 | 10 |
| Khudri | 2.39 | 1.72 | 32 | 51 | 28 | 19 |
| Nabt-ul-Saif | 2.57 | 2.48 | 34 | 55 | 28 | 13 |
| Sugai | 2.40 | 1.70 | 38 | 53 | 19 | 8 |
| Shishi | 2.24 | 1.75 | 30 | 58 | 26 | 7 |
| Sultana | 2.32 | 1.67 | 32 | 53 | 24 | 20 |
| Medjoul | 0.80 | 0.70 | 14 | 32 | 0 | 0 |
| Raziz | 1.00 | 0.83 | 16 | 37 | 0 | 0 |
| Lulu | 1.10 | 0.87 | 18 | 36 | 0 | 0 |
| Nemeishi | 1.20 | 0.85 | 16 | 42 | 0 | 0 |
| Zamli | 1.10 | 0.98 | 18 | 45 | 0 | 0 |

Table 25: Fruit quality attributes of different exotic date palm varieties

| Variety | Single Fruit Weight (g) | Fruit Length (cm) | Fruit Breadth (cm) | Stone Weight (g) | Stone pulp ratio (%) | Yield /plant (kg) |
|--------------|-------------------------|-------------------|--------------------|------------------|----------------------|-------------------|
| Ajwa | 12.3 | 2.6 | 2.1 | 0.6 | 11.6 | 60 |
| Amber | 23.0 | 4.8 | 2.8 | 1.5 | 13.0 | 80 |
| Barhee | 10.8 | 2.4 | 1.9 | 0.9 | 9.7 | 95 |
| Khalas | 21.0 | 4.4 | 2.7 | 1.5 | 13.1 | 75 |
| Khudri | 9.8 | 2.5 | 1.7 | 0.7 | 9.6 | 77 |
| Nabt-ul-Saif | 14.2 | 3.0 | 2.6 | 1.4 | 14.0 | 55 |
| Sugai | 18.6 | 4.1 | 2.3 | 1.5 | 11.0 | 70 |
| Shishi | 13.2 | 3.5 | 2.4 | 1.6 | 16.0 | 45 |
| Sultana | 14.4 | 3.0 | 2.5 | 1.2 | 13.0 | 35 |

22. Characterization and documentation of Date Palm (*Phoenix dactylifera*) and Ber (*Ziziphus mauritiana*) germplasm

Selection of approved, high yielding variety is the main thing to consider while a person is heading towards orchard establishment. However, we are lacking in this respect as a number of fruits have no registered varieties. Therefore, characterization and documentation of different traits of eleven strains of Date Palm (Braum, Gajjar, Ajwa, Amber, Barhee, Khalas, Khudri, Nubtul Saif, Sugai, Shishi & Sultana) and two strains of Ber (Akash & Moon) were recorded. The results regarding yielding capacity of various strains revealed that Braim had the highest yield at Dhoka stage (110-120 kg per plant) followed by Barhee (90-100 kg per plant) and Amber (70-80 kg per plant). Braim strain expressed excellent characteristics for eating at Khalal stage as it had maximum yield range, followed by Barhee strain with at Khalal stage. Amber strain showed maximum fruit size (4.7 cm length x 3.2 cm width), single fruit weight (28 g) with best quality Tamar, followed by Sugai and Ajwa for using as Tamar. Gajjar is a large fruit size strain (4.8 cm length x 2.8 cm width) that has a better yield range (80-95kg/plant) and very good for using in Rutab stage (Table 25). In case of Ber strains, Akash (Fig.18) is a late season strain and had potential yield (140-160 kg per plant), while Moon (Fig.19) is mid-season strain and had potential yield (150-170 kg per plant). Fruit of Moon strain is heavier & more attractive than Akash strain (Table 26).



Fig. 19: Stone, fruit and transverse section of fruit of AKASH strain (L to R)



Fig.20: Stone, fruit and transverse section of fruit of MOON strain (L to R)

Table 26: Salient Characteristics of Date Palm Strains

| Date palm Strains | Fruit Size (L x W) cm | Fruit weight (g) | Stone % | Yield/plant (kg) | Best eating stage |
|-------------------|-----------------------|------------------|---------|------------------|-------------------|
| Braim | 3.2 x 2.5 | 10 | 16 | 110-120 | Khalal |
| Gajjar | 4.8 x 2.8 | 14 | 12 | 80-95 | Rutab |
| Ajwa | 2.5 x 2.0 | 11 | 16 | 70-80 | Tamar |
| Amber | 4.7 x 3.2 | 28 | 13 | 70-80 | Tamar |
| Barhee | 2.5 x 2.2 | 10 | 10 | 90-100 | Khalal |
| Khalas | 3.8 x 2.6 | 20 | 13 | 75-85 | Rutab, Tamar |
| Khudri | 2.5 x 2.3 | 10 | 9 | 75-85 | Rutab |
| Nabtul Saif | 3.2 x 2.5 | 13 | 14 | 55-70 | Khalal |
| Sugai | 3.9 x 2.4 | 18 | 11 | 70-90 | Tamar |
| Shishi | 3.2 x 2.5 | 14 | 16 | 65-75 | Khalal |
| Sultana | 3.2 x 2.4 | 15 | 13 | 45-60 | Khalal |

Table 27: Salient Characteristics of Ber Strains

| Ber Strains | Fruit Size (L x W) cm | Fruit weight (g) | Pulp% | TSS% | Moisture % | Yield/plant (kg) |
|--------------|-----------------------|------------------|-------|-------|------------|------------------|
| Akash | 3.5 x 2.8 | 17 | 94 | 14-16 | 85-90 | 140-160 |
| Moon | 3.6 x 3.5 | 19 | 96 | 15-17 | 87-93 | 150-170 |

23. **Integrated approach to control cracking of fruit in Pomegranate (*Punica granatum L.*)**

Pomegranate (*Punica granatum L.*) belongs to the family Punicaceae. It is one of the most delicious as well as nutritious fruit. With understanding of its nutritional, medicinal and pharmaceutical importance as well as developments in production, postharvest techniques and food technology, it has become a popular and economically important fruit crop around the world. Fruit cracking is a physiological disorder of pomegranate, which deteriorates quality of fruit and results in heavy economic losses in southern Punjab. Horticultural Research Station planned and conducted experiment to find out the best chemical combination to control fruit cracking of Pomegranate. The experiment consists of seven treatments (Table 28) that was replicated thrice in RCBD lay out.

Highest number of fruits/plant (236), minimum number of cracked fruits (17), the lowest cracking percentage (7%), maximum fruit weight (188 g) and maximum yield (44 kg/plant) were recorded in T₅ {spray of Streptomycin (1g/liter) + Nativo (1g/liter) at monthly interval from May-July. While, lowest number of fruits/plant (170), maximum cracked fruit (37), the highest cracking percentage (19%), minimum fruit weight (131 g) and minimum yield (24 kg/plant) was recorded in untreated plants (control) as given in Table 29.

It was concluded that foliar spray of various chemicals such as Streptomycin (bactericide) + Nativo (fungicide) and Isabion (amino acids) at monthly interval during fruit growth had reduced fruit cracking percentage and improved fruit characteristics. It had been concluded from results of this study that foliar spray of Streptomycin (1g/liter) + Nativo (1g/liter) at monthly interval from May-July gave the best result with minimum cracking, maximum number of fruit per plant), maximum fruit weight and the highest yield per plant in comparison to other treatments.

Table 28: Description of treatments combinations

| Treatment | Description |
|------------------|--|
| T ₁ | Spray of Streptomycin sulphate (1g/liter) at monthly interval from May-July. |
| T ₂ | Spray of Isabion (1ml/liter) at monthly interval from May-July. |
| T ₃ | Spray of Nativo (1g/liter) at monthly interval from May-July. |

| | |
|----------------|--|
| T ₄ | Spray of Streptomycin sulphate (1g/liter) + Isabion (1ml/liter) at monthly interval from May-July. |
| T ₅ | Spray of Streptomycin (1g/liter) +Nativo (1g/liter) at monthly interval from May-July. |
| T ₆ | Spray of Isabion (1ml/liter) + Nativo (1g/liter) at monthly interval from May-July. |
| T ₇ | Control. |

Table 29: Fruit quality and yield parameters of pomegranate as affected by treatment combinations

| Treatment | No. of fruits / plant | No. of cracked fruits / plant | %age of cracked fruit | Single Fruit weight (g) | Fruit size Length (cm) | Fruit size Width (cm) | Yield / plant (Kg) |
|----------------|-----------------------|-------------------------------|-----------------------|-------------------------|------------------------|-----------------------|--------------------|
| T ₁ | 226 | 24 | 11 | 151 | 6.63 | 6.53 | 34 |
| T ₂ | 220 | 32 | 15 | 146 | 6.66 | 6.36 | 32 |
| T ₃ | 230 | 20 | 9 | 158 | 6.96 | 6.76 | 36 |
| T ₄ | 191 | 29 | 15 | 171 | 7.00 | 6.90 | 33 |
| T ₅ | 236 | 17 | 7 | 188 | 7.33 | 7.10 | 44 |
| T ₆ | 190 | 22 | 13 | 160 | 6.63 | 6.46 | 26 |
| T ₇ | 170 | 37 | 19 | 131 | 6.00 | 5.63 | 24 |

24. Studies on genetic diversity of exotic Date palm seedlings under climatic conditions of Bahawalpur

In entire Punjab there is limited number of promising date palm cultivars. Attempt was made to plant stones of high market value date palm varieties and to find out promising chance seedlings of Date palm with elite characteristics.

The fungicide treated stones of ten elite Arabian Date palm varieties i.e. Ajwa, Amber, Mubroom, Sugai, Safawi, Khudri, Sukri, Barni, Khalas and Halwa were soaked in warm water for 12 hours and then sown in polythene bags (containing 25% leaf mold, 25% silt and 50% organic fertilizer). The seedlings were sprinkled / watered every fourth day. Chloropyriphos (2%) was applied to the seedlings in spring & autumn months to avoid attack of termite. The

optimum dose of nutrition and irrigation was applied for the early completion of juvenile phase. The experiment was laid out according to CRD with five replications. Each treatment contained 10 stones per replication. Mubroom led in plant height (161 cm), Stem girth (8.4 cm) and number of pinnae / frond (29), followed by Khudri (160 cm plant height) and led in number of fronds (12) and frond length (122 cm) from seedlings raised during 2017 (Table 30). It is concluded from the study that seedlings of Safawi, Khudri, Mubroom and Amber are showing good vegetative growth in arid climatic conditions of Punjab.

Table 30: Fruit quality and yield parameters of pomegranate as affected by treatment combinations

| Variety | Av. Plant height (cm) | Av. Stem girth (cm) | Av. No. of fronds | Av. Frond Length (cm) | Av. No. of pinnae / frond |
|---------|-----------------------|---------------------|-------------------|-----------------------|---------------------------|
| Ajwa | 122 | 7.0 | 8 | 106 | 16 |
| Amber | 131 | 6.5 | 10 | 116 | 18 |
| Mubroom | 161 | 8.4 | 11 | 114 | 29 |
| Sugai | 155 | 5.7 | 8 | 115 | 15 |
| Safawi | 125 | 6.9 | 9 | 84 | 21 |
| Khudri | 160 | 6.9 | 12 | 122 | 20 |
| Sukri | 159 | 7.0 | 9 | 110 | 20 |
| Barni | 135 | 6.9 | 10 | 111 | 26 |
| Khalas | 111 | 6.4 | 8 | 93 | 14 |
| Halwa | 113 | 6.7 | 10 | 101 | 14 |

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