# Annual Report 2019-20

**Barani Agricultural Research Institute Chakwal**

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# CONTENTS

**OVERVIEW: BARANI AGRICULTURAL RESEARCH INSTITUTE, CHAKWAL**

Barani tract consists of 3.10 million hectares of the total cultivated area 11.83 million hectares of the Punjab Province having different ecological zones with varied soil type and rainfall pattern. Barani Agricultural Research Institute, Chakwal was established in 1979 to tackle the agricultural problems of the barani areas i.e., whole of Attock, Rawalpindi, Jhelum and Chakwal and parts of Sialkot, Narowal, Gujrat, Khushab, Mianwali, Jhang, Bhakkar, Layyah, D.G. Khan and Rajanpur districts. This institute is entrusted mainly with the task for the evolution of varieties of different crops possessing desirable agronomic traits with high yield potential alongwith development of crop production technology best suited for the Barani tract. Crop management in the Barani tract almost entirely depends upon natural precipitation.

Being a multi-disciplinary institute, it has 7 research disciplines viz. Crop Breeding, Agronomy, Soil Science, Plant Protection, Horticulture, Economics & Statistics and Agricultural Engineering. Moreover, five stations/sub-stations namely Barani Agricultural Research Station, Fatehjang, Groundnut Research Station, Attock, Gram Breeding Research Sub-Station, Attock, Horticultural Research Station, Soan Valley, Nowshera and Cotton Research Sub-Station, Piplan are also working under the administrative and technical control of this Institute.

A team of devoted high qualified research scientists being led by Dr. Muhammad Tariq, Director is engaged in conducting research on almost all the major crops of Barani area viz. Groundnut, Mung, Mash, Sorghum, Millets, Cowpeas, Wheat, Chickpea, Lentil, Brassica, Vegetables and Fruits etc. This institute is one of the leading institutes of the Pakistan working for the welfare of farmers of the Barani tract and is helping to alleviate poverty from the country. The main objectives of the Institute are: Collection, maintenance and evaluation of germplasm of different crops for utilization in hybridization programme.

## Objectives:

- Development of high yielding, drought tolerant and disease resistant crop varieties of cereals, food legumes, oilseeds, fodders, fruits and vegetables
- Standardization of appropriate production technologies for field and fruit crops
- Production of breeders and basic seed
- Propagation of true to type fruit plants

- Introduction of high value crop off-season vegetables, high efficiency irrigations systems and value addition of different crops
- Transfer of modern crop production technology to farming community of Barani areas through farmer's day electronic and print media

## Location & Area


**Total Area** **220 acres**

**Research Area** **160 acres**

**BREEDING**

**WHEAT** (***Triticum aestivum*** L.)

**Objectives**

- Collection and maintenance of genotypes of diversified genetic back-ground with a view to develop new recombinants through crossing among strains/lines possessing desirable economic characters.
- Development of high yielding wheat cultivars tolerant to drought and tolerant to diseases.
- Study the performance of different wheat nurseries/trials received from various agencies under barani conditions.
- To study grain yield performance and other characters of promising lines selected from different nurseries and filial generations.
- To evaluate yield performance of different promising lines received from different Research Institutes /stations under different barani zones.
- To produce pure and true to type seed of advance wheat lines and commercial varieties of this Institute in order to facilitate their availabil-ity to the farming community of the area.

**1.Maintenance of Gene Pool**

Gene pool comprising of 170 local and exotic varieties/lines having desirable traits like high grain yield, plant type, good quality, drought, heat and cold tolerance and resistance to diseases was sown keeping a plot size of 1.125$m^2$. The rows were kept 22.5cm apart and fertilizer was applied @ 90-60-60 NPK Kg/ha. The gene pool was sown on 11-11-2019 and harvested on 05-05-2020. Seed of all entries was collected for use in next year and following parameters were studies as shown in Table 1:

**Table 1: Characters Studies and their Rang in Genepool studies**

| Sr. No. | Characters studied | Range |
|---|---|---|
| 1- | Days to heading (No.) | 100– 115 |
| 2- | Plant height (cm) | 68 – 105 |
| 3- | Spike length (cm) | 6.3 – 15.2 |
| 4- | No. of Spikelets /spike | 15– 23 |

| | | |
|---|---|---|
| 5- | No. of Grains/spike | 24 – 65 |
| 6- | 1000-grain weight (g) | 20 – 45 |
| 7- | Grain yield (kg/ha) | 1210 – 4825 |
| 8- | Days taken to maturity | 135 – 152 |

**Wheat Improvement Programme Through Hybridization**

150 crosses were attempted and 105 were found successfully harvested. $F_0$ of these crosses were collected for further studies.

**2.Study of Filial Generations**

Segregating populations were evaluated for different desirable characters like good plant type and resistance to disease etc. as show in Table 2:

**Table 2: Filial Generations Studied & Selected**

| Filial Generations | Entries studied | Entries selected |
|---|---|---|
| Fresh Crosses | 150 Crosses | 105 Crosses |
| $F_1$ | 31 progenies | 25 Progenies |
| $F_2$ | 43 Progenies | 30 progenies |
| $F_3$ | 42 Progenies | 25 progenies |
| $F_4$ | 41 Progenies | 25 progenies |
| $F_6$ | 180 SHR | 30 progenies |
| **Total entries** | **487** | **240** |

**3.Evaluation of Screening Nurseries/Trials**

The following trials / nurseries received from CIMMYT/ICARDA were studied under medium rainfall conditions. The fertilizer was applied @90:60:60 kg/ha of Nitrogen, Phosphorus and Potash respectively. A total of 767 entries were evaluated and 68 were selected on the basis of yield and other traits desirable for rainfed areas. Detail is as under in Table 3:

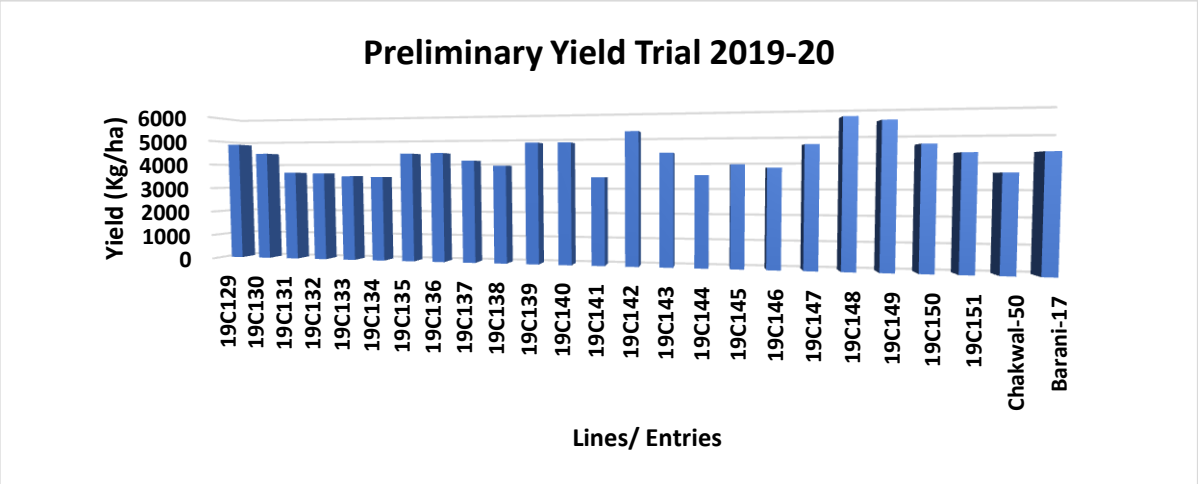
**Table 3: Wheat Nurseries/ Trials**

| S. No | Trial/Nursery | Entries studied | Entries selected |
|---|---|---|---|
| 1. | Semi-Arid Wheat Yield Trial (SAWYT) | 50 | 12 |
| 1. | Wheat Yield Trial Heat Tolerance (HYT) | 100 | 10 |
| 2. | Elite Spring Wheat Yield Trial (ESWYT) | 50 | 12 |
| 3. | International Bread Wheat Screening Nursery (IBWSN) | 284 | 18 |
| 4. | Semi-Arid Wheat Screening Nursery (SAWSN) | 283 | 18 |
| **Total** | | **767** | **70** |

**4.Preliminary Yield Trial**

Twenty-three promising lines were evaluated for their yield performance against two check varieties i.e., Chakwal-50 and Barani-17. The trial was sown on 29-10-2019 following Alpha Lattice Design with two replications keeping a plot size of 4.5m$^2$. The rows were kept 22.5 cm apart. Fertilizer was applied @ 90-60-60 NPK Kg/ha respectively. The trial was harvested on 15-05-2020. The yield data of the best performing lines is given below in Figure 1:

**Figure 1: Yield Performance of Entries included in Preliminary Yield Trial 2019-20**

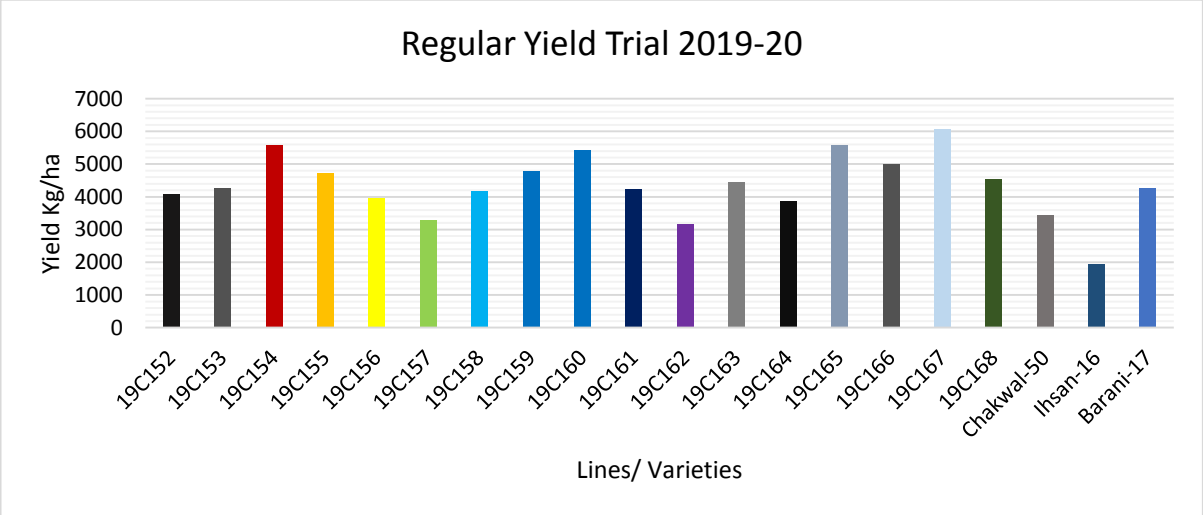


Significant differences were found among the test entries for their yield performance. 12 entries gave higher yield than one check varieties Barani-17. Highest average yield was 5678 Kg/ha from 19C148 followed by 19C149 (5533 Kg/ha).

**5.Regular Yield Trial (B-Trial)**

The trial was conducted to evaluate yield performance of 17 promising wheat lines against three commercial varieties viz: Ihsan-16, Chakwal-50 and Barani-17. The trial was sown on 29-10-2019 following Alpha Lattice Design with two replications keeping a plot size of 4.5m$^2$. The rows were kept 22.5cm apart. Fertilizer was applied @ 90-60-60 NPK Kg/ha respectively. The trial was harvested on 12-05-2020. The yield data were recorded and given in Figure 2:

**Figure 2: Yield Performance of Entries included in Regular Yield Trial 2019-20**



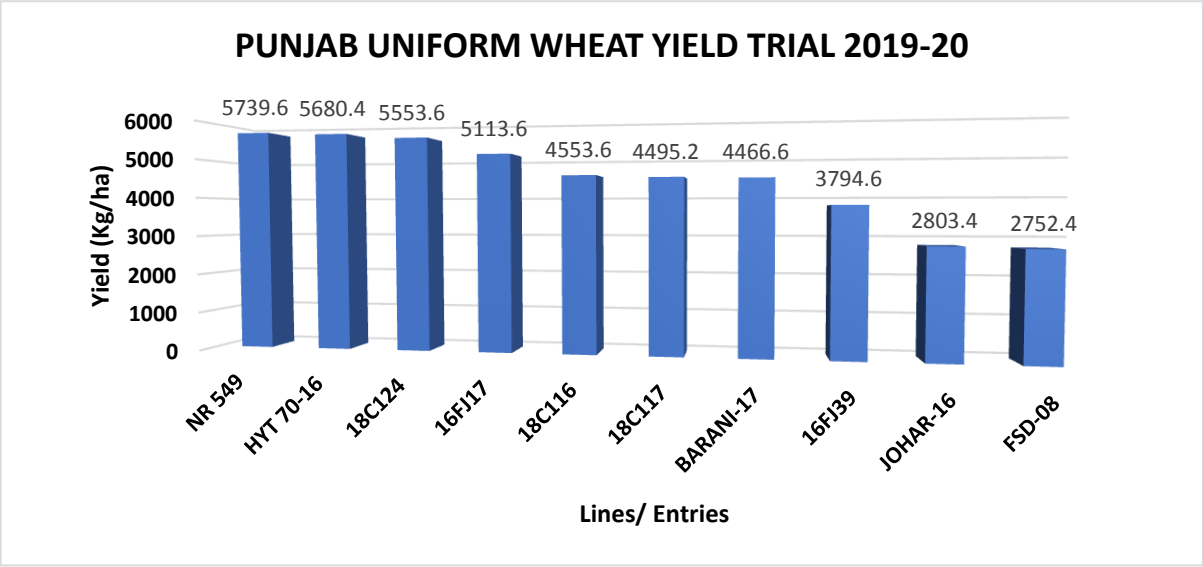

The data revealed highly significant differences among the test entries for yield performance. Nine entries gave higher grain yield than the three check varieties. Entry 19C167 gave the maximum yield of 6067 kg/ha. The check varieties Ihsan-16, Chakwal-50 and Barani-17 produced 1939, 3428 and 4261 kg/ha respectively.

**6.Punjab Uniform Wheat Yield Trial (PUWYT)**

Punjab uniform wheat yield trial comprising 50 advance wheat lines contributed by various research centers of the Punjab were received from Wheat Research Institute, Faisalabad to evaluate their yield performance and other desirable characters under rainfed conditions. The trial was sown at Barani Agricultural

Research Institute, Chakwal on 30-10-2019 and harvested on 10-05-2020. The trial was laid out following Alpha lattice Design with two replications, keeping a plot size of 5m x 0.9m and row spacing of 22.5cm. The fertilizer was applied @ 90-60-60 NPK kg/ha, respectively. The grain yield data were recorded and presented in Figure 3:

**Figure 3: Ranked Yield Data (Kg / ha) of Punjab Uniform Wheat Yield Trial 2019-20**




Fifty test entries along with check varieties were evaluated for their performance during 2019-20. **NR 549** gave the maximum yield of 5740 kg/ha followed by **HYT 70-16** which produced 5680 kg/ha. The candidate line **18C124** from BARI, Chakwal produced the yield of 5554 kg/ha and got the third position in Punjab rainfed conditions.

**7.National Uniform Wheat Yield Trial (NUWYT) 2019-20**

Sixty advance wheat lines contributed by various research centers of the country were received from NARC, Islamabad to evaluate their yield performance and other desirable characters under rainfed conditions against local check variety Barani-17. The trial was sown at Barani Agricultural Research Institute, Chakwal on 19-11-2019 and harvested on 20-05-2020. The trial was laid out following Alpha lattice design with two replications, keeping a net plot size of 5m × 1.35m and row spacing of 22.5 cm. The fertilizer was applied @ 90-60-60 NPK kg/ha respectively. The yield data were recorded analyzed statistically and is given below in Table 4:

**Table 4: Yield Data (Kg/ha) of National Uniform Wheat Yield Trial 2019-20**

| Entry No. | Yield (Kg/ha) | Ent No. | Yield (Kg/ha) |
|---|---|---|---|
| 1 | 3400 | 31 | 3748 |
| 2 | 4422 | 32 | 3222 |
| 3 | 3733 | 33 | 4267 |
| 4 | 2504 | 34 | 4985 |
| 5 | 3363 | 35 | 5519 |
| 6 | 4519 | 36 | 4985 |
| 7 | 4726 | 37 | 5852 |
| 8 | 4785 | 38 | 1496 |
| 9 | 5237 | 39 | 4437 |
| 10 | 3148 | 40 | 3548 |
| 11 | 2341 | 41 | 4652 |
| 12 | 4437 | 42 | 3504 |
| 13 | 4437 | 43 | 6222 |
| 14 | 3267 | 44 | 4830 |
| 15 | 5044 | 45 | 5015 |
| 16 | 3311 | 46 | 3970 |
| 17 | 2859 | 47 | 6067 |
| 18 | 3141 | 48 | 4933 |
| 19 | 3911 | 49 | 6141 |
| 20 | 4622 | 50 | 4378 |
| 21 | 3363 | 51 | 4704 |
| 22 | 2637 | 52 | 4511 |
| 23 | 4222 | 53 | 2496 |
| 24 | 3844 | 54 | 4548 |
| 25 | 5200 | 55 | 3519 |
| 26 | 4585 | 56 | 3659 |
| 27 | 3956 | 57 | 2422 |

| | | | |
|---|---|---|---|
| 28 | 5422 | 58 | 4778 |
| 29 | 3363 | 59 | 5963 |
| 30 | 4178 | 60 | 3778 |

**8.Nucleus Seed Production**

To maintain the purity and to produce true-to-type seed of commercial varieties and advance lines of wheat, following selections were made as shown in Table 5:

**Table 5**: **Selection of Wheat Lines for Nucleus Seed Production**

| **Sr. No.** | Variety/line | **Heads selected** | **Rows sown** | **Rows selected** | **Blocks sown** | **Blocks selected (Breeder's Seed produced in Kg.)** |
|---|---|---|---|---|---|---|
| 1 | Dharabi-2011 | 200 | 200 | 50 | 20 | 60 |
| 2 | Chakwal-50 | 200 | 200 | 50 | 40 | 60 |
| 3 | Ihsan-16 | 200 | 200 | 50 | 20 | 60 |
| 4 | Barani-17 | 200 | 200 | 120 | 40 | 100 |
| 5 | 16C038 | 200 | 200 | 150 | 0 | 0 |

**GROUNDNUT (*Arachis hypogaea* L.)**

**Objectives:**

- Introduction, selection, hybridization and development of high yielding, disease and drought tolerant varieties of groundnut for rainfed areas of Punjab.

**1.Groundnut Gene Pool**

Two hundred and fifteen entries varieties/strains of diversified genetic background were sown on 18-04-19 in single row plots of 4m length to study their performance under Barani conditions. Plant spacing between and within rows were maintained at 15cm and 60cm respectively. Fertilizers @ 20-80-20 NPK Kg/ha were applied at the time of seed bed preparation. Gypsum @ 500 kg/ha was applied on 19-07-2019. All

entries were retained on the basis of number of pods and yield per plant and also four new entries were added for further studies during the next year.

**2. Hybridization Programme**

A crossing block comprising of five desirable varieties / advance lines viz; 10CG001, yH-4, BC-170, 96CG005 and chakori was sown in pots on 20-04-19 under field conditions for crossing work. Following crosses (Table 6) were attempted during July, 2019. All crosses were successful. Crossed pods were collected and their seed will be utilized for sowing as $F_1$ generation next year.

**Table 6**: **Crosses of Wheat Lines in Hybridization Program**

| S. No. | Crosses | Characters to be incorporated |
|---|---|---|
| 1- | 10CG001 X yH-4 | High yielding + Good filling X Early maturing |
| 2- | BC-170 X yH-4 | High yielding + Good filling X Good taste + Early maturing |
| 3- | 96CG005 X yH-4 | High yielding + High Protein + High Oil Contents X Early maturing |
| 4- | 10CG001 X Chakori | High yielding + Good filling X Good taste + High Protein + High Oil Contents |

**3. Study of Filial Generations ($F_1$, $F_2$, $F_3$, $F_4$, $F_5$, $F_6$ & $F_7$)**

Three $F_1$ progenies of groundnut were sown along with parents. The sowing of $F_1$ material was done on 22-04-2019, keeping a plot size according to the availability of seed. Row and plant spacing within rows were maintained at 60 cm & 30 cm respectively. In all crosses, crossed plants were harvested and the pods were collected for sowing next year as $F_2$ segregating generation. In case of $F_2$, progenies of three crosses were sown according to availability of their seed along with parents. The sowing of $F_2$ generation was done on 25-04-2019. Row and plant spacing were maintained at 45 cm and 30 cm respectively. Nine progenies were selected for further studying of segregating behavior in $F_3$ generation. Forty-five progenies of $F_3$ were sown along with their parents. Plant spacing within rows were maintained at 25 cm and row to row 45 cm. Thirty-one progenies were selected for sowing $F_4$ generation next year. Fifty-five single plant selections of $F_4$ were sown on 25-04-2019 and thirty-five progenies were selected to sow as $F_5$ generation next year.

Forty progenies of $F_5$ were studied; out of this material twenty-four progenies were selected and fifteen progenies were selected from thirty-two progenies of $F_6$ generation. Twenty-one progenies of $F_7$ were studied in 2019 and ten entries were selected from this material while six entries from this material were included in the preliminary yield trial.

The size of plots was depending upon the availability of seed. Fertilizers @ 20-80-20 Kg of NPK/ha were applied at the time of seedbed preparation and gypsum @ 500 Kg/ha was applied at the flowering stage on 19-07-19 in all above mentioned filial generations' experiments.

## 4. Preliminary Yield Trial

Five promising lines were evaluated for their yield performance against check varieties; BARI-2011 and BARI-2016. The experiment was sown on 18-04-2019 in Randomized Complete Block Design (RCBD) with three replications, keeping a plot size of 4m x 1.8m. The rows were spaced at 45 cm apart while plant spacing within rows were maintained at 20 cm. Fertilizers @ 20-80-20 Kg of NPK/ha was also applied at the time of seed-bed preparation and gypsum @ 500 Kg/ha was also applied on 19-07-2019. Data on pod yield were recorded, statistically analyzed and are presented in the following Table 7: -

**Table 7: Average Pod Yield of Various Entries**

| S. No. | Entry | Pod Yield (kg/ha) | S. No. | Entry | Pod Yield (kg/ha) |
|---|---|---|---|---|---|
| 1 | 19CG004 | 3611 | 5 | BARI-2016 (c) | 2593 |
| 2 | 19CG001 | 3519 | 6 | 19CG002 | 2500 |
| 3 | BARI-2011 (c) | 3519 | 7 | 19CG003 | 2315 |
| 4 | 19CG005 | 3333 | | | |
| LSD (0.05) = 302.4 CV (%) = 8.0<br>LSD (0.05) = 237.4 kg/ha<br>CV (%) = 7.4 | | | | | |

19CG004 gave highest pod yield (3611kg/ha) than all the testing entries and both check varieties BARI-2011 and BARI-2016. 19CG003 was the lowest yielder (2315 kg/ha) among the test entries.

**5.Regular Yield Trial**

Seven entries including two checks were tested for their yield potential under rainfed conditions. The trial was sown on 18-04-2019 in Randomized Completed Block Design with three replications. The plot size was 4 m x 1.8 m. The rows were spaced at 45 cm apart while the plant spacing within rows were maintained 20 cm. Fertilizers @ 20-80-20 kg of NPK/ha were applied at the time of seed-bed preparation. Gypsum @ 500 kg/ha was also applied on 19-07-2019. Data for yield and yield components were recorded. Statistically analyzed yield data are given below in Table 8: -

**Table 8: Average Pod Yield of Various Entries**

| S. No. | Entry | Pod Yield (kg/ha) | S. No. | Entry | Pod Yield (kg/ha) |
|---|---|---|---|---|---|
| 1 | 18CG005 | 4352 | 5 | BARI-2011 (c) | 3287 |
| 2 | 18CG004 | 4074 | 6 | 18CG002 | 2963 |
| 3 | 18CG003 | 3889 | 7 | 18CG001 | 2269 |
| 4 | BARI-2016 (c) | 3889 | | | |

LSD (0.05) = 243.7 kg/ha

CV (%) = 8.2

Entry 18CG005 gave comparatively higher pod yield (4352 kg/ha) than check varieties BARI-2011 and BARI-2016 and all other test entries while 18CG001was lowest yielder with dry pod yield 2269 kg/ha.

**6.Micro Yield Trial**

Fourteen advance promising lines were evaluated for their yield potential against check varieties BARI-2011 and BARI-2016. The trial was sown in Randomized Completed Block Design with three replications. The plot size was 4m x 2.7m. The rows were spaced at 45 cm apart while the plant spacing within rows were maintained 20 cm. Fertilizers @ 20-80-20 kg of NPK /ha were applied before the

time of sowing. Gypsum @ 500 kg/ha was also applied on 19-07-2019. Data for dry pod yield and yield components were recorded. Statistically analyzed yield data are given below in Table 9:

**Table 9: Average Pod Yields (kg/ha) of Various Entries**

| S. No. | Entries | Average Pod Yield (kg/ha) |
|---|---|---|
| 1 | 17CG004 | 5824 |
| 2 | 17CG002 | 5782 |
| 4 | 17AK002 | 5509 |
| 5 | 17CG005 | 5491 |
| 6 | 16CG005 | 5366 |
| 7 | 16CG002 | 5231 |
| 8 | 17AK001 | 5042 |
| 9 | 17AK005 | 5032 |
| 10 | 17CG003 | 4889 |
| 11 | 16CG006 | 4838 |
| 12 | 16CG004 | 4806 |
| 13 | BARI-11 (C) | 4759 |
| 14 | 16CG001 | 4741 |
| 15 | 17AK004 | 4731 |
| 16 | BARI-16 (C) | 4060 |
| | LSD (0.05) = 240.9 CV (%) = 12.3 | |

Entry 17CG004 gave comparatively higher pod yield (5824 kg/ha) than check varieties BARI-2011 and BARI-2016.

**7.National Uniform Groundnut Yield Trial**

Ten promising/candidate lines were evaluated for their pod yield performance. The trial was sown on 19-04-2019 in Randomized Completed Block Design with three replications. The plot size was 4 m x 1.8 m. The rows were spaced at 45 cm apart while the plant spacing within rows were maintained 20 cm. Fertilizers @ 20-80-20

kg of NPK/ha were applied before the time of seed-bed preparation. Gypsum @ 500 kg/ha was also applied at flowering stage. Data for yield and yield components were recorded. Statistically analyzed yield data are given below in Table 10: -

**Table 10:Dry Pod Yield of Various Entries of National Uniform Groundnut Yield Trial**

| Sr. No. | Entry | Pod Yield ( kg/ha) | Sr. No. | Entry | Pod Yield (kg/ha) |
|---|---|---|---|---|---|
| 1 | 11AK011 | 3036 | 6 | 10CG001 | 2690 |
| 2 | 10AK003 | 3017 | 7 | PG-1090 | 2614 |
| 3 | PG-1267 | 2954 | 8 | ICG-11855 | 2580 |
| 4 | ICG-6590 | 2903 | 9 | 13CG003 | 2548 |
| 5 | BARI-2011 (C) | 2885 | 10 | ICG-2271 | 2548 |
| | LSD (0.05) = 371.1 | | CV (%) = 6.7 | | |

Entry 11AK011 gave the highest pod yield 3036 kg/ha followed by entry 10AK003 with pod yield 3017 kg/ha. The lowest dry pod yield (2548 kg/ha) was obtained from entry ICG-2271.

**8.Nucleus Seed Production**

Sowing of approved variety BARI-2011 and latest groundnut variety BARI-2016 for nucleus seed production was done on 19.04.19. Inter & intra row plant spacing was kept at 45 cm and 17-20 cm respectively. All other agronomic practices were kept uniform. Gypsum @500 kg/ha was also applied on 20-07-2019. Seventy kg seed from BARI-2011 and One hundred & forty kg from BARI-2016 seed was produced as BNS by sowing progeny lines. Two hundred kg seed from BARI-2011 and Four hundred kg from BARI-2016 seed was produced as Pre-basic in 2019.

Following BNS and Pre-basic seed in Table 11 was produced during 2019.

**Table 11: BNS and Pre-basic seed of different varieties/lines**

| S. No. | Name of variety/line | BNS (kg) | Pre-basic (kg) |
|---|---|---|---|
| 1 | BARI-2011 | 70 | 200 |

| | | | |
|---|---|---|---|
| 2 | BARI-2016 | 140 | 400 |

**PULSES**

**MASH (*Vigna mungo*)**

**Objectives**

- Development of high yielding and disease resistant mash varieties suitable for barani tract of Pothowar region.

**1.Maintenance of Germplasm**

Mash germplasm comprising of two hundred entries originating from local and exotic sources was evaluated. The experiment was sown using augmented design on 26-07-2019 keeping a plot size of 4.0m x 0.3m. Recommended crop management practices were adopted. Data on different agronomic characteristics were recorded. The experiment was harvested on 19-11-2019. Traits variability range observed in the germplasm is as under (Table 12):

**Table 12: Traits diversity present in Germplasm**

| Plant trait | Minimum | Maximum |
|---|---|---|
| **Plant height (cm )** | 39.8 | 53.2 |
| **Pr. Branches/plant (#)** | 1.4 | 2.4 |
| **Days to flowering (50%)** | 53.0 | 61.0 |
| **Pods/plant (#)** | 3.0 | 22.6 |
| **Pod length (cm )** | 4.1 | 4.6 |
| **Seeds /pod (#)** | 4.8 | 5.8 |
| **Days to maturity (90%)** | 107.0 | 110.0 |
| **100 seed wt. (g)** | 4.1 | 4.9 |
| **Seed yield (g/plot) 1.2m$^2$** | **70.0** | **200.0** |

**2.Study of Filial Generations**

To evaluate and select desirable recombinants, early (F1 – F3) and advance (F4 – F6) generations were evaluated in the field.
i. Early Generations (F1 – F3)

**a) F1 Generation**

Twelve $F_1$ progenies of mash were sown along with parents. $F_1$ progenies were sown keeping a plot size according to seed availability. Fertilizer @ 20-50-0 kg of NPK/ha was applied, to all generations at the time of seedbed preparation. In all crosses, crossed plants were found and seed was collected for sowing next year as $F_2$ segregation generations.

**b) F2 Generation**

In $F_2$ Ten segregating populations were sown along with their parents. Plot size was kept according to seed availability. Plant spacing within rows were maintained at 10 cm and row to row 30 cm. Out of this material, fifty desirable single plants were selected on the basis of a greater number of pods, disease tolerance and high seed yield for sowing of $F_3$ during next year.

**c) F3 Generation**

Twenty single plant progenies of $F_3$ were sown. The size of plot was depending upon the availability of seed. Plant spacing within rows were maintained at 10 cm and row to row 30 cm. Out of this material, forty desirable single plants were selected for sowing as $F_4$ generation.

**ii. Advance Generations (F4 – F7)**

In $F_4$, twenty progenies were sown according to availability of their seed. Forty desirable single plants were selected for sowing as $F_5$ generation next year.

Ten progenies of $F_5$ were sown according to availability of their seed. Out of this material, thirty desirable single plants were selected for attaining homozygosity in $F_6$ generation.

Ten progenies of $F_6$ were sown according to availability of their seed. These desirable genotypes were selected for sowing during next year in preliminary yield trial.

### 3.Crossing Block

To induce genetic variability, ten crosses were attempted among the selected mash genotypes possessing high seed yield, short stature and more pods/plant (Table 13). 40 flowers/cross were attempted. Recommended crop management practices were adopted for healthy crop stand. All the crosses were successful and $F_0$ seed of these successful crosses was harvested for further evaluation in filial generations.

**Table 13: Attempted crosses among desirable mash genotypes**

| Sr. No. | High yield | | More pods/plant |
|---|---|---|---|
| **1** | 11 CM-707 | X | **CHAKWAL MASH** |
| **2** | 13CM-708 | X | **AROOJ** |
| **3** | 13CM-710 | X | **CHAKWAL MASH** |
| **4** | 14CM-705 | X | **AROOJ** |
| **5** | CHAKWAL MASH | X | **AROOJ** |
| **6** | CHAKWAL MASH | X | **11CM-707** |
| **7** | AROOJ | X | **13CM-708** |
| **8** | AROOJ | X | **13CM-710** |
| **9** | 11 CM-707 | X | **13CM-708** |
| **10** | **13CM-710** | **X** | **14CM-705** |

### 4.Mash Yield Trials

#### i. Preliminary yield trial

This experiment was conducted to evaluate high yielding and disease resistant mash lines. Twelve entries were evaluated against two check varieties; Chakwal Mash and Arooj. The experiment was sown on 22-07-2019, using RCBD with three replications in plots of 4.0m x 0.9m. Fertilizer @ 20-50-0 kg of NPK/ha was applied and recommended plant protection measures were adopted. The experiment was harvested on 11-11-2019.

Seed yield data were recorded and analyzed (Table 14). Results depicted significant differences among the lines evaluated. Five lines gave higher seed yield than better check variety Chakwal Mash (556 kg/ha). 18CM-712 with a seed yield of 500 kg/ha produced the lowest yield among the tested genotypes.

**Table 14: Average Seed Yield of Various Mash Genotypes tested in Preliminary Yield Trial**

| S. No. | ENTRIES | Yield kg/ha |
|---|---|---|
| **1** | 18CM-704 | **704** |
| **2** | 18CM-705 | **704** |
| **3** | 18CM-708 | **620** |
| **4** | 18CM-702 | **593** |
| **5** | 18CM-711 | **556** |
| **6** | CH-MASH (C) | **556** |
| **7** | 18CM-710 | **547** |
| **8** | 18CM-701 | **546** |
| **9** | 18CM-707 | **537** |
| **10** | 18CM-709 | **537** |
| **11** | AROOJ (C) | **519** |
| **12** | 18CM-703 | **509** |
| **13** | 18CM-706 | **509** |
| **14** | 18CM-712 | **500** |
| | **LSD (0.05)** | **41.5** |
| | **CV (%)** | **12.1** |

### ii. Mash Regular Yield Trial

This experiment was conducted to evaluate high yielding and disease resistant mash lines. Ten entries were evaluated against two check varieties Chakwal Mash and Arooj. The experiment was sown on 23-07-2019 following RCBD with three replications in plots of 4.0 x 1.2m. Fertilizer @ 20-50-0 kg of NPK/ha was applied and recommended plant protection measures were adopted. The experiment was harvested on 11-11-2019.

Seed yield data were recorded and analyzed (Table 15). Significant differences for seed yield were observed among the lines. Three entries out-yielded the best check variety Chakwal mash (881 kg/ha). Arooj gave the lowest yield of 564 kg/ha.

**Table 15: Average Seed Yield of Mash Entries tested in Regular yield trial**

| S. No. | ENTRIES | Yield kg/ha |
|---|---|---|
| **1** | 17CM-703 | **925** |
| **2** | 17CM-706 | **917** |
| **3** | 17CM-702 | **882** |
| **4** | Ch-mash (C) | **881** |
| **5** | 17CM-710 | **778** |
| **6** | 17CM-707 | **769** |
| **7** | 17CM-705 | **758** |
| **8** | 17CM-704 | **750** |
| **9** | 17CM-701 | **722** |
| **10** | 17CM-708 | **703** |
| **11** | 17CM-709 | **686** |
| **12** | Arooj (C) | **564** |
| **13** | **LSD (0.05)**<br>**CV (%)** | **56.5**<br>**11.9** |

### iii. Mash Micro Yield Trial

Ten advance lines were evaluated for seed yield performance against two check varieties, Chakwal Mash and Arooj. The experiment was sown on 23-07-2019 using RCBD with three replications. The plot size was kept 4.0m x 1.2m. Fertilizer @ 20-

50-0 kg of NPK/ha was applied and recommended plant protection measures were adopted. Experiment was harvested on 08-11-2019.

Seed yield data were recorded and analyzed (Table 16). Significant differences for seed yield were observed among the lines. Seven entries gave higher seed yield than best check variety Chakwal Mash (583 kg/ha). The lowest yield was obtained from Arooj (493 kg/ha)

**Table 16: Average Seed Yield of Mash Entries in Micro Yield Trial**

| S. No | ENTRIES | Yield kg/ha |
|---|---|---|
| **1** | 16CM-701 | **805** |
| **2** | 16CM-702 | **667** |
| **3** | 16CM-708 | **646** |
| **4** | 16CM-706 | **632** |
| **5** | 16CM-705 | **625** |
| **6** | 16CM-704 | **590** |
| **7** | 16CM-709 | **590** |
| **8** | CH-Mash(C) | **583** |
| **9** | 16CM-703 | **556** |
| **10** | 16CM-707 | **542** |
| **11** | 16CM-710 | **500** |
| **12** | Arooj (C) | **493** |
| | **LSD (0.05)**<br>**CV (%)** | **43.5**<br>**8.9** |

### iv. Mashbean Advance Yield Trial

Ten lines were evaluated for yield performance against two check varieties Chakwal Mash and Arooj. The experiment was sown on 24-07-2019 using RCBD with three replications. The plot size was kept 4.0m x 1.2m. Experiment was harvested on 30-11-2019.

Yield data were recorded and analyzed (Table 17). Two entries gave higher seed yield than check variety Chakwal Mash (590 kg/ha). The lowest seed yield was obtained from Arooj (417 kg/ha).

**Table 17: Average Seed Yield of Mash Entries in Advance yield trial**

| S. No\ | ENTRIES | Seed Yield (kg/ha) |
|---|---|---|
| **1** | 15CM-704 | **750** |
| **2** | 15CM-701 | **632** |
| **3** | CH MASH | **590** |
| **4** | 15CM-702 | **549** |
| **5** | 15CM-710 | **549** |
| **6** | 15CM-709 | **514** |
| **7** | 15CM-703 | **486** |
| **8** | 15CM-708 | **486** |
| **9** | 15CM-706 | **472** |
| **10** | 15CM-705 | **458** |
| **11** | 15CM-707 | **451** |
| **12** | AROOJ | **417** |
| | **LSD (0.05)** | **41.0** |
| | **CV (%)** | **9.5** |

**5.Mash National Uniform Yield Trial**

Seventeen entries/lines of mash were evaluated for their grain yield. The experiment was planted on 25-07-2019 in a RCBD fashion with three replications. The plot size was kept 4.0 x 1.2m. The experiment was harvested on 26-11-2019. The yield data were recorded and analyzed (table 18).

Significant differences were observed among the entries. The highest seed yield was obtained by entries MS19005, MS19011 and MS19020 which was 694 kg/ha. Whereas, MS109015 produced lowest yield (537 kg/ha).

**Table 18: Average Seed Yield of Mash Lines in National Uniform Yield Trial**

| S. No. | ENTRIES | Yield kg/ha |
|---|---|---|
| **1** | MS19005 | **694** |
| **2** | MS19011 | **694** |
| **3** | MS19020 | **694** |
| **4** | MS19001 | **676** |
| **5** | MS19030 | **667** |
| **6** | MS19009 | **648** |
| **7** | MS19033 | **629** |
| **8** | MS19036 | **620** |
| **9** | MS19044 | **611** |
| **10** | MS19046 | **611** |
| **11** | MS19040 | **593** |
| **12** | MS19024 | **583** |
| **13** | MS19013 | **574** |
| **14** | MS19042 | **574** |
| **15** | MS19026 | **574** |
| **16** | MS19048 | **546** |
| **17** | MS19015 | **537** |
| | **LSD (0.05)** | **54.2** |
| | **CV (%)** | **14.6** |

**6.Nucleus Seed Production**

100 plant to row progenies and 50 blocks of Chakwal Mash were planted on 24-7-2019 and 10 kg BNS of Chakwal Mash was produced. 100 plant to row progenies and 40 blocks of Barani Mash were planted on 24-7-2019 and 15 kg BNS of Barani Mash was produced.

**RABI TRIALS 2019-20**

**LENTIL (*Lens culinaris* M.)**

**Objectives**

- Development of high yielding and disease resistant lentil varieties suitable for barani tract of Pothowar region.

**1.Maintenance of Germplasm**

Lentil germplasm comprising of one hundred and twenty entries originating from local and exotic sources was evaluated. The experiment was sown on 16-10-2019, using augmented design keeping plot size of 4.0 m x 0.3 m. Recommended crop management practices were adopted. Data on different agronomic characteristics were recorded. The experiment was harvested on 23-04-2020. Traits variability range observed in the germplasm is as under (Table 19):-

**Table 19: Traits diversity present in Lentil Germplasm**

| Plant trait | Minimum | Maximum |
|---|---|---|
| **Germination (% age)** | 90 | 95 |
| **Plant height (cm)** | 39 | 51 |
| **No. of Primary branches/plant (#)** | 1.4 | 2.4 |
| **Days to flowering (50%)** | 127 | 135 |
| **No. of Pods/plant (#)** | 9 | 24 |
| **No. of Seeds /pod (#)** | 1.2 | 1.8 |
| **No. of Days to maturity (90%)** | 179 | 184 |
| **Seed yield (g/1.2 $m^2$)** | **140** | **390** |

**2.Study of Filial Generations**

To evaluate and select desirable recombinants, early (F1 – F3) and advance (F4 – F6) generations were evaluated in the field.

i. Early Generations (F1 – F3)

**a) F1 Generation**

Twelve (12) $F_1$ crosses of lentil were sown along with parents. $F_1$ crosses were sown keeping a plot size according to seed availability. Fertilizer @ 20-50-0 kg of NPK/ha was applied, to all crosses at the time of seedbed preparation. In all crosses,

crossed plants were found and seed was collected for sowing in the next year as $F_2$ segregating generations.

**b) F2 Generation**

In $F_2$, twelve crosses were sown along with their parents. Plot size was kept according to seed availability. Plant spacing within rows were maintained at 10 cm and row to row 30 cm. Out of this material, one hundred and fifty (150) desirable single plants were selected for sowing $F_3$ during next year.

**c) F3 Generation**

One hundred and thirty progenies of $F_3$ were sown. Plot size was kept according to seed availability. Plant spacing within rows were maintained at 10 cm and row to row 30 cm. Out of this material, forty desirable single plants were selected for sowing as $F_4$ generation. Out of this material, 36 desirable single plants were selected for sowing as $F_4$ generation.

**ii. Advance Generations (F4 – F7)**

In $F_4$, sixty (60) progenies were sown according to availability of their seed. 20 desirable single plants were selected for sowing as $F_5$ generation next year.

In case of $F_5$, forty-eight progenies were sown according to the availability of their seed. 10 desirable single plants were selected for sowing as $F_6$ generation in the next year.

In case of $F_6$, thirty progenies were sown according to availability of their seed. These desirable genotypes were selected for sowing during next year in preliminary yield trial.

**3.Crossing Block**

To induce genetic variability, twelve crosses were attempted among the selected lentil genotypes possessing high seed yield, and more pods/plant (Table 20). Recommended crop management practices were adopted for healthy crop stand. All the crosses were successful and $F_0$ seed of these successful crosses was harvested for further evaluation in filial generations.

**Table 20: Success percentage of attempted crosses among selected high yielding lentil genotypes**

| Sr. No. | Cross/parents | Success (%age) |
|---|---|---|
| **1** | Ch. Masoor X PB. Masoor-09 | **15** |
| **2** | Ch. Masoor X 16 CL-307 | **20** |
| **3** | Ch. Masoor X 16 CL-303 | **20** |
| **4** | PB. Masoor-09 X Ch. Masoor | **14** |
| | PB. Masoor-09 X 16CL-307 | **10** |
| **6** | PB. Masoor-09 X 16 CL-303 | **18** |
| **7** | 16CL-307 X Chakwal Masoor | **18** |
| **8** | 16CL-307 X PB. Masoor-09 | **14** |
| **9** | 16CL-307 X 16CL-303 | **16** |
| **10** | 16CL-303 X Chakwal Masoor | **15** |
| **11** | 16CL-303 X PB. Masoor-09 | **20** |
| **12** | **16CL-303 X 16CL-307** | **20** |

**4.Lentil Yield Trials**

**i. Preliminary Yield Trial**

This experiment was conducted to evaluate high yielding and disease resistant lentil lines. Nine entries were evaluated for yield performance against three check varieties, Chakwal Masoor, Pb. M-09 and Markaz-09. The experiment was sown on 10-10-2019 using randomized complete block design with three replications in plot size of 4.0 m x 1.2 m and row spacing of 30 cm. Fertilizer @ 20-50-0 kg of NPK/ha was applied, and recommended plant protection measures were adopted. The experiment was harvested on 16-04-2020.

Seed yield data were recorded and analyzed (Table 21). Results depicted significant differences among the lines evaluated. Two entries gave higher yield than check varieties i.e. Punjab Masoor-09 and Chakwal Masoor. 19CL-106 produced the highest yield (777 kg/ha) and 19CL-105 produced the lowest yield (472 kg/ha).

**Table 21: Average Seed Yield of Various Lentil Genotypes tested in Preliminary Yield Trial**

| Sr. No. | Genotypes | Seed Yield (kg/ha) |
|---|---|---|
| **1** | 19CL-106 | **777.67** |
| **2** | 19CL-107 | **736.00** |
| **3** | Ch Masoor | **715.33** |
| **4** | P. Masoor | **708.33** |
| **5** | 19CL-103 | **701.33** |
| **6** | 19CL-109 | **666.67** |
| **7** | 19CL-101 | **632.00** |
| **8** | 19CL-102 | **604.00** |
| **9** | Markaz-09 | **576.33** |
| **10** | 19CL-108 | **548.67** |
| **11** | 19CL-104 | **500.00** |
| **12** | 19CL-105 | **472.33** |
| | **CV %** | **11.04** |
| | **LSD (0.05)** | |

**ii Lentil Regular Yield Trial**

This experiment was conducted to evaluate high yielding and disease resistant lentil lines. Nine entries were evaluated against three check varieties, Chakwal Masoor, Punjab Masoor-09 and Markaz-09. The experiment was sown on 11-10-2019 following randomized complete block design with three replications in plots of 4.0 m x 1.2 m and row spacing of 30 cm. Fertilizer @ 20-50-0 kg of NPK/ha was applied, and recommended plant protection measures were adopted. The experiment was harvested on 17-04-2020.

Seed yield data were recorded and analyzed (Table 22). Results depicted significant differences among the lines evaluated. Four entries gave better yield than check variety Punjab Masoor. Entry 18CL-303 gave the best yield (888.67 kg/ha) followed by entry 18CL-304 (833.33 kg/ha). Chakwal Masoor gave the lowest yield of 555.67 kg/ha.

**Table 22: Average Seed Yield of Various Lentil Genotypes**

| Sr.No. | Genotypes | Seed Yield (kg/ha) |
|---|---|---|
| **1** | 18CL-303 | **888.67** |
| **2** | 18CL-304 | **833.00** |
| **3** | 18CL-307 | **784.67** |
| **4** | 18CL-308 | **771.00** |
| **5** | P. Masoor 09 | **736.00** |
| **6** | 18CL-305 | **694.33** |
| **7** | 18CL-301 | **687.67** |
| **8** | 18CL-302 | **680.67** |
| **9** | 18CL-306 | **659.67** |
| **10** | 18CL-309 | **583.33** |
| **11** | Markaz-09 | **569.33** |
| **12** | Ch Masoor | **555.67** |
| | **CV %** | **9.62** |
| | **LSD (0.05)** | **114.68** |

### iii. Lentil Micro Yield Trial

Nine genotypes were evaluated at two different locations for yield performance against three check varieties, Chakwal Masoor, Punjab Masoor-09 and Markaz-09. The experiment was sown using randomized complete block design with three replications. The plot size was kept 4.0 m X 1.2 m and row spacing of 30 cm.

The experiment was harvested and yield data were recorded, analyzed statistically (Table 23). Significant differences for seed yield were observed among the lines Eight genotypes/entries gave higher yield than check varieties i.e, .Markaz-09, Punjab-Masoor 09 and Chakwal Masoor. Entry 17CL-306 gave the best seed yield (1496 kg/ha). while 17CL-307 gave the lowest yield (1077 kg/ha).

**Table 23: Average Seed Yield of Various Lentil Genotypes in Micro Yield Trial**

| S.No. | Genotypes | BARI | GRS, | Means |
|---|---|---|---|---|

| | | Chakwal | Attock | |
|---|---|---|---|---|
| **1** | 17CL-306 | 805.33 | 2188.30 | 1496.82 |
| **2** | 17CL-305 | 785.00 | 2030.90 | 1407.95 |
| **3** | 17CL-301 | 847.00 | 1956.80 | 1401.90 |
| **4** | 17CL-303 | 889.00 | 1833.33 | 1361.17 |
| **5** | 17CL-302 | 833.00 | 1830.20 | 1331.60 |
| **6** | 17CL-304 | 861.00 | 1768.50 | 1314.75 |
| **7** | 17CL-309 | 909.67 | 1700.60 | 1305.14 |
| **8** | 17CL-308 | 743.33 | 1746.90 | 1245.12 |
| **9** | Markaz-09 | 666.67 | 1814.80 | 1240.74 |
| **10** | P. Masoor 09 | 874.67 | 1601.90 | 1238.29 |
| **11** | Ch Masoor | 743.00 | 1642.00 | 1192.50 |
| **12** | 17CL-307 | 812.67 | 1342.60 | 1077.64 |
| | CV %<br>LSD (0.05) | 9.06<br>97.38 | 9.54<br>155.98 | |

### iv. Lentil Advance Yield Trial

Eight entries were evaluated against three check varieties, Chakwal Masoor, Punjab Masoor-09 and Markaz-09. The experiment was sown on 12-10-2019 following randomized complete block design with three replications in plots of 4.0 m x 1.2 m and row spacing of 30cm. Experiment was harvested on 21-04-2020.

Yield data were recorded and analyzed (Table 24). Significant differences for seed yield were observed among the genotypes. 16CL-307 gave the best seed yield (944.67 kg/ha) followed by 16 CL-302 (826 kg/ha). P. Masoor gave the lowest yield of 653 kg/ha.

**Table 24: Average Seed Yield of Various Lentil Genotypes in Advance Yield Trial**

| S. No | ENTRIES | Yield kg/ha |
|---|---|---|
| **1** | 16CL-307 | **944.67** |
| **2** | 16CL-302 | **826.33** |
| **3** | Ch Masoor | **784.67** |
| **4** | 16CL-308 | **764.00** |
| **5** | 16CL-303 | **750.00** |
| **6** | 16CL-304 | **743.00** |
| **7** | 16CL-305 | **722.33** |
| **8** | 16CL-301 | **715.33** |
| **9** | 16CL-306 | **694.67** |
| **10** | Markaz-09 | **653.00** |
| **11** | P. Masoor | **653.00** |
| | **CV %** | **7.05** |
| | **LSD (0.05)** | **90.01** |

**5.Lentil National Uniform Yield Trial**

Twenty-one entries of lentil were evaluated for their grain yield. The experiment was planted on 30-10-2019 in a RCBD fashion with three replications. The plot size was kept 4.0 x 1.2m. The experiment was harvested on 14-04-2020.

The yield data were recorded and analyzed (Table 25). Significant differences for seed yield were observed among the genotypes. Entry L 19045 gave the best seed yield (756.93 kg/ha) followed by L 19059 (736 kg/ha). Entry L 19008 gave the lowest yield of 423 kg/ha.

**Table 25: Average seed yield of lentil lines (kg/ha) in National Uniform Yield Trial**

| S. no | Entries | Seed yield (Kg/ha) |
|---|---|---|
| **1** | L 19045 | 756.93 |
| **2** | L 19059 | 736.04 |
| **3** | L 19039 | 701.40 |
| **4** | L 19028 | 680.56 |

| | | |
|---|---|---|
| **5** | L 19017 | 673.60 |
| **6** | L 19011 | 666.67 |
| **7** | L 19026 | 652.77 |
| **8** | L 19037 | 645.83 |
| **9** | L 19030 | 638.90 |
| **10** | L 19021 | 638.89 |
| **11** | L 19049 | 631.94 |
| **12** | L 19042 | 625.00 |
| **13** | L 19024 | 611.04 |
| **14** | L 19014 | 590.20 |
| **15** | L 19060 | 534.73 |
| **16** | L 19057 | 520.83 |
| **17** | L 19055 | 506.94 |
| **18** | L 19003 | 506.91 |
| **19** | L 19006 | 500.00 |
| **20** | L 19033 | 486.10 |
| **21** | L 19008 | 423.60 |
| | CV %<br>LSD(0.05) | 13.22<br>63.48 |

**6. Nucleus Seed Production**

150 plants to row progenies and 60 blocks of Chakwal Masoor were planted. BNS 10 kg of Chakwal Masoor was produced during the year.

**CHICKPEA (*Cicer arietinum*)**

Unfortunately, all chickpea (Kabuli) trials of rabi 2019-20 failed due to heavy rains with thunderstorms and gram pod borer attack.

**1. NUCLEUS SEED PRODUCTION**

150 plants to row progenies and 60 blocks of Tamman were planted. BNS 10 kg of Tamman was produced during the year. 100 plants to row progenies and 30 blocks

of Balkassar and Wanhar were planted. 10 kg BNS of Balkassar and 05 kg BNS of Wanhar was produced during the year (Table 26).

**Table 26: BNS Production of Chickpea varieties**

| Varieties | Weight (Kg) |
|---|---|
| **Tamman** | 10 |
| **Balkassar** | 10 |
| **Wanhar** | 05 |

## OILSEEDS

### RAPESEED (*Brassica napus*)

### 1.Maintenance of Rapeseed Genepool

73 Entries of Rapeseed were sown on 14.10.2019 for preliminary evaluation in plots of 5.0m x 0.6m. These genotypes are collected to maintain the germplasm with greater genetic diversity for introduction and to use in hybridization programme. Eight genotypes were selected on the basis of their apparent agronomic performance. These selected genotypes will be tested in the preliminary yield trial next year.

Data on following parameters were recorded and presented in table 27 below:

**Table 27: Different parameters of Rapeseed Genepool**

| Sr. No. | Traits studied | Range |
|---|---|---|
| 1 | Plant height (cm) | 170-270 |
| 2 | Pods/Plant (no.) | 568-1720 |
| 3 | Seeds/Pod (no.) | 07-18 |
| 4 | Days to Flowering | 50-55 |
| 5 | Days to Maturity | 150-181 |

| | | |
|---|---|---|
| 6 | Grain Yield (Kg/ha) | 900-3100 |

**2.Rapeseed Preliminary Yield Trial**

Six Rapeseed genotypes including one check variety, namely Chakwal Sarsoon were evaluated for their yield performance. The trial was planted on 10.10.2019 using randomized complete block design with three replications. The plot size was 5.0 m x 1.2 m with 45 cm apart rows. The experiment was harvested on 15.04.2020 Yield data were recorded and analyzed. The results are presented in the table 28 below:

**Table 28: Average Grain yield of various Rapeseed Genotypes in PYT**

| Sr. No | Entries | Grain Yield (kg/ha) |
|---|---|---|
| 1 | 19CBN001 | 2361 |
| 2 | 19CBN002 | 1528 |
| 3 | 19CBN003 | 2778 |
| 4 | 19CBN004 | 2111 |
| 5 | 19CBN005 | 2472 |
| 6 | Chakwal Sarsoon | 3278 |
| LSD 0.05 | | 129.28 |
| CV % | | 10.41 |

Significant differences were found among the entry means for their grain yield.

**3.Rapeseed Regular Yield Trial**

Ten genotypes including two check varieties namely Faisal Canola and Chakwal Sarsoon were planted on 10.09.2019. The trial was planted following randomized complete block design with three replications keeping a plot size of 5.0 m x 1.2 m and a row spacing of 45 cm. The experiment was harvested on 15.04.2020. Yield data were recorded, analyzed using analysis of variance technique. The results are presented in the table 29 below:

**Table 29: Average Grain yield of various Rapeseed Genotypes in RYT**

| Sr. No. | Entries | Grain Yield (kg/ha) |
|---|---|---|
| 1 | 18CBN001 | 3361 |
| 2 | 18CBN002 | 3056 |
| 3 | 18CBN003 | 2778 |
| 4 | 18CBN004 | 3167 |
| 5 | 18CBN005 | 3000 |
| 6 | 18CBN006 | 2917 |
| 7 | 18CBN007 | 2861 |
| 8 | 18CBN008 | 3278 |
| 9 | Faisal Canola | 2722 |
| 10 | Chakwal Sarsoon | 2556 |
| LSD 0.05 | | 125.94 |
| CV % | | 11.34 |

Table: Average Grain yield of Various Rapeseed Genotypes in RYT Significant differences were found among the varietals means for seed yield. All genotypes performed better and gave higher grain yield as compared to better check variety Faisal Canola and Chakwal Sarsoon. The check varieties Chakwal Sarsoon and Faisal Canola produced a grain yield of 2556 kg/ha and 2556 kg/ha respectively.

**4.Rapeseed Micro Yield Trial**

Eleven entries of Rapeseed were evaluated for grain yield performance. The trial was planted in the month of October, 2020 following randomized complete block design with three replications keeping a plot size of 5.0m x 1.2 m with a row spacing of 45 cm. The experiment was harvested on 14.04.2020. Yield data were recorded, analysed using analysis of variance technique. The results are presented in the table 30 below:

**Table 30: Average Grain yield of various Rapeseed Genotypes in MYT**

| Sr. No | Entries | Grain Yield (kg/ha) |
|---|---|---|
| 1. | A | 2361 |
| 2. | B | 1722 |

| | | |
|---|---|---|
| 3. | C | 2417 |
| 4. | D | 1583 |
| 5. | E | 1611 |
| 6. | F | 1650 |
| 7. | G | 1500 |
| 8. | H | 1778 |
| 9. | I | 2250 |
| 10. | J | 2139 |
| 11. | K | 1944 |

**1. Genetic Improvement Through Hybridization**

Ten crosses were attempted among the selected parents and six crosses were successful and $F_0$ seed of their crosses was harvested and collected for further study.

**2. Study of Filial Generations ($F_1$)**

Ten crosses/progenies were studied and four crosses/plants/progenies were selected seed was harvested and collected for further study as in Table 31: -

**Table 31: Crosses studies and Crosses selected from Filial Generations**

| **Filial Generations** | **Crosses/progenies** studied | **Crosses/plants/ Progenies selected** |
|---|---|---|
| **$F_1$** | **10** | **04** |

**5.Rapeseed National Uniform Yield Trial**

Twenty-one National Uniform Yield entries of Rapeseed were evaluated for grain yield performance. The experiment was planted in October 2020 in a randomized complete block design with three replications. The plot size was kept 5.0m x 1.2m with row spacing of 45 cm. The experiment was harvested on 16.04.2020. The yield data were recorded, analyzed, and results are presented in the Table 32 below:

**Table 32: Yield data recorded, analyzed, and results of NUYT**

| Sr. No | Entries | Grain Yield (kg/ha) |
|---|---|---|
| 1. | Can-190081 | 3628 |
| 2. | Can-190082 | 2656 |
| 3. | Rap-190091 | 1446 |
| 4. | Rap-190092 | 2194 |
| 5. | Rap-190093 | 2617 |
| 6. | Rap-190094 | 1733 |
| 7. | Rap-190095 | 2378 |
| 8. | Rap-190096 | 2222 |
| 9. | Rap-190097 | 3061 |
| 10. | Rap-190098 | 2189 |
| 11. | Rap-190099 | 1806 |
| 12. | Rap-190100 | 2006 |
| 13. | Rap-190101 | 2550 |
| 14. | Rap-190083 | 1978 |
| 15. | Rap-190084 | 3000 |
| 16. | Rap-190085 | 2983 |
| 17. | Rap-190086 | 2611 |
| 18. | Rap-190087 | 1500 |
| 19. | Rap-190088 | 3044 |
| 20. | Hyola-401 | 3000 |
| 21. | Super Canola | 3133 |

**MUSTARD** *(Brassica juncea)*

**6.Maintenance of Mustard Genepool**

Forty Mustard entries were evaluated at Barani Agricultural Research Institute, Chakwal. The experiment was sown on 09.10.2019, keeping a plot size of 5.0 m x 0.6 m. Six genotypes were selected on the basis of their apparent agronomic performance. These selected genotypes will be tested in the preliminary yield trial next year. Data on following parameters were recorded and presented in Table 33 below:

**Table 33: Data on different parameters for Mustard Genepool**

| **Trait Studied** | | |
|---|---|---|
| **Sr. No.** | **Parameters studied** | **Range** |
| **1** | Plant Height/Plant (cm) | **190-270** |
| **2** | Days to flowering | **50-56** |
| **3** | Days to maturity | **160-187** |
| **4** | Pods/Plant (no.) | **510-1570** |
| **5** | Seeds/ Pod (no.) | **07-17** |
| **6** | **Seed Yield (kg/ha)** | **600-2050** |

**7.Mustard Preliminary Yield Trial**

Six mustard genotypes including one check variety, namely Khanpur Raya were evaluated for their yield performance. The trial was planted on 09.10.2019 using randomized complete block design with three replications. The plot size was 5.0m x 1.2m with 45 cm apart rows. The experiment was harvested on 17.04.2020. Yield data were recorded and analyzed. The results are presented in the table 34 below:

**Table 34: Average Grain yield of various Mustard Genotypes in PYT**

| **Sr. No** | **Entries** | **Grain Yield (kg/ha)** |
|---|---|---|

| | | |
|---|---|---|
| 1 | 19CBJ001 | 1306 |
| 2 | 19CBJ002 | 1306 |
| 3 | 19CBJ003 | 1194 |
| 4 | 19CBJ004 | 1306 |
| 5 | 19CBJ005 | 1528 |
| 6 | Khanpur Raya | 1500 |
| LSD 0.05 | | 63.30 |
| CV % | | 10.83 |

Significant differences were found among the entry means for their grain yield.

**8.Mustard Regular Yield Trial**

Eight mustard genotypes including one check variety, namely Khanpur Raya were evaluated for their yield performance. The trial was planted on 14.10.2020 using randomized complete block design with three replications. The plot size was 5.0m x 1.2m with 45 cm apart rows. The experiment was harvested on 16.04.2020 Yield data were recorded and analyzed. The results are presented in the table 35 below:

**Table 35: Average Grain yield of various Mustard Genotypes in RYT**

| Sr. No | Entries | Grain Yield (kg/ha) |
|---|---|---|
| 1 | 18CBJ001 | 1250 |
| 2 | 18CBJ002 | 1178 |
| 3 | 18CBJ003 | 1289 |
| 4 | 18CBJ004 | 1344 |
| 5 | 18CBJ005 | 1172 |
| 6 | 18CBJ006 | 1350 |
| 7 | 18CBJ007 | 1361 |
| 8 | Khanpur Raya | 1311 |
| LSD 0.05 | | 49.37 |
| CV % | | 11.08 |

Significant differences were found among the entry means for their grain yield. Three genotypes performed better and gave a higher grain yield than check variety Khanpur Raya which produced a grain yield of 1311 kg/ha.

**9.Mustard Micro Yield Trial**

Twelve genotypes were evaluated for yield performance. The experiment was planted in the month of October, 2020 using randomized complete block design with three replications. The plot size was kept 5.0m x 1.2m and row spacing of 45 cm. The experiment was harvested on 16.04.2020.

Yield data were recorded analyzed statistically and result are presented below in Table 36:-

**Table 36: Statistically analyzed and results of MYT**

| Sr. No | Entries | Grain Yield (kg/ha) |
|---|---|---|
| 1. | **1** | 1400 |
| 2. | **2** | 1289 |
| 3. | **3** | 1194 |
| 4. | **4** | 1370 |
| 5. | **5** | 1067 |
| 6. | **6** | 1361 |
| 7. | **7** | 1161 |
| 8. | **8** | 1311 |
| 9. | **9** | 1222 |

**10.Mustard National Uniform Yield Trial**

Thirty-five Mustard genotypes were evaluated for their grain yield performance. The experiment was planted in October 2020, following randomized complete block design with three replications in plots of 5.0m x 1.2m and row spacing of 45 cm. The

experiment was harvested on 14.04.2020. Data on seed yield were recorded, analyzed and results are presented in the table below:

**Table 37: Statistically analyzed and results of NUYT**

| Sr. No | Entries | Grain Yield (kg/ha) |
|---|---|---|
| 12. | Mu-190050 | 1649 |
| 13. | Mu-190052 | 1556 |
| 14. | Mu-190053 | 1417 |
| 15. | Mu-190054 | 1472 |
| 16. | Mu-190056 | 1589 |
| 17. | Mu-190058 | 1439 |
| 18. | Mu-190059 | 1556 |
| 19. | Mu-190061 | 1328 |
| 20. | Mu-190062 | 1350 |
| 21. | Mu-190063 | 1478 |
| 22. | Mu-190064 | 1444 |
| 23. | Mu-190065 | 1328 |
| 24. | Mu-190066 | 1394 |
| 25. | Mu-190067 | 1944 |
| 26. | Mu-190068 | 1428 |
| 27. | Mu-190069 | 2161 |
| 28. | Mu-190070 | 1044 |
| 29. | Mu-190071 | 1461 |
| 30. | Mu-190072 | 972 |

| | | |
|---|---|---|
| 31. | Mu-190073 | 1533 |
| 32. | Mu-190074 | 1750 |
| 33. | Mu-190075 | 1622 |
| 34. | Mu-190076 | 1289 |
| 35. | Mu-190077 | 1722 |
| 36. | Mu-190078 | 1638 |
| 37. | Mu-190079 | 2000 |
| 38. | Mu-190080 | 1278 |
| 39. | Mu-190081 | 1056 |
| 40. | Mu-190082 | 1872 |
| 41. | Mu-190083 | 1778 |
| 42. | Mu-190084 | 1822 |
| 43. | Mu-190085 | 2061 |
| 44. | Mu-190086 | 1250 |
| 45. | Super Raya | 1500 |
| 46. | Coral-432 | 1920 |

**TARAMIRA** *(Eruca sativa)*

### 11.Maintenance of Taramira Genepool

Fifty-three Taramira entries were evaluated at Barani Agricultural Research Institute, Chakwal. The experiment was sown on 15-10-2019, keeping a plot size of 5.0 m x 0.6 m. Several genotypes were selected on the basis of their apparent agronomic performance. These selected genotypes will be tested in the preliminary yield trial next year. Data on following parameters were recorded and presented in table 38 below:

**Table 38: Parameters studies in Taramira Genepool**

| Sr.No. | Parameters studied | Range |
|---|---|---|
| 1 | Plant Height/Plant (cm) | 132-170 |
| 2 | Days to maturity (70%) | 168-191 |
| 3 | Seed Yield (kg/ha) | 500-1166 |

## 12.Taramira Preliminary Yield Trial

Six Taramira genotypes including one check variety were evaluated for their yield performance. The trial was planted on 15.10.2020 using randomized complete block design with three replications. The plot size was 5.0m x 1.2m with 45 cm apart rows. The experiment was harvested on 17.04.20202. Yield data were recorded and analyzed. The results are presented in the table 39 below:

**Table 39: Average Grain yield of various Taramira Genotypes in PYT**

| Sr. No | Entries | Grain Yield (kg/ha) |
|---|---|---|
| 1 | CES003644 | 1306 |
| 2 | CES003650 | 1306 |
| 3 | CES003653 | 1194 |
| 4 | CES003674 | 1306 |
| 5 | CES00368 | 1528 |
| 6 | Taramira | 1500 |
| LSD 0.05 | | 20.26 |
| CV % | | 9.99 |

Significant differences were found among the entry means for their grain yield. One genotype, CES00368 performed better and gave a higher grain yield of CES00368 kg/ha than check variety which produced a grain yield of 1500 kg/ha.

## 12.Taramira Regular Yield Trial

Eight Taramira genotypes including one check variety were evaluated for their yield performance. The trial was planted on 11.11.19 using randomized complete block design with three replications. The plot size was 5.0m x 1.2m with 45 cm apart rows. The experiment was harvested on 17.04.2020. Yield data were recorded and analyzed. The results are presented in the table 40 below:

**Table 40: Average Grain yield of various Taramira Genotypes in RYT**

| Sr. No | Entries | Grain Yield (kg/ha) |
|---|---|---|
| 1 | 18CES001 | 736 |
| 2 | 18CES002 | 639 |
| 3 | 18CES003 | 656 |
| 4 | 18CES004 | 689 |
| 5 | 18CES005 | 661 |
| 6 | 18CES006 | 681 |
| 7 | 18CES007 | 792 |
| 8 | Taramira | 706 |
| LSD 0.05 | | 45.99 |
| CV % | | 16.82 |

Significant differences were found among the entry means for their grain yield. Two genotypes, 18CES001 and 18CES007 performed better and gave a higher grain yield of 736 kg/ha and 792 kg/ha respectively than check variety which produced a grain yield of 706 kg/ha.

## 13.Taramira Micro Yield Trial

Ten Taramira genotypes including one check variety were evaluated for their yield performance. The trial was planted on 11.10.2020 using randomized complete block design with three replications. The plot size was 5.0m x 1.2m with 45 cm apart rows.

The experiment was harvested on 17.04.2020. Yield data were recorded and analyzed. The results are presented in the table 41 below:

**Table 41: Average Grain yield of various Taramira Genotypes in MYT**

| Sr. No | Entries | Grain Yield (kg/ha) |
|---|---|---|
| 1 | 17CES001 | 822 |
| 2 | 17CES002 | 911 |
| 3 | 17CES003 | 833 |
| 4 | 17CES004 | 606 |
| 5 | 17CES005 | 633 |
| 6 | 17CES006 | 794 |
| 7 | 17CES007 | 761 |
| 8 | 17CES008 | 683 |
| 9 | 17CES009 | 883 |
| 10 | Taramira | 844 |
| LSD 0.05<br>CV % | | 46.26<br>13.64 |

Significant differences were found among the entry means for their grain yield. Two genotypes 17CES002 and 17CES009 performed better and gave a higher grain yield than check variety which produced a grain yield of 844 kg/ha.

## 14.Taramira National Uniform Yield Trial

Eight Taramira genotypes were evaluated for their grain yield performance. The experiment was planted in October 2020, following randomized complete block design with three replications in plots of 5.0m x 1.2m and row spacing of 45 cm. The experiment was harvested on 14.04.2020. Data on seed yield were recorded, analyzed and results are presented in the table 42 below:

**Table 42: Average Grain yield of various Taramira Genotypes in NUYT**

| Sr. No | Entries | Grain Yield (kg/ha) |
|---|---|---|
| 1. | Ta-19001 | 489 |
| 2. | Ta-19002 | 494 |
| 3. | Ta-19003 | 644 |
| 4. | Ta-19004 | 456 |
| 5. | Ta-19005 | 656 |
| 6. | Ta-19006 | 494 |
| 7. | Ta-13016 | 628 |
| 8. | Ta-13023 | 722 |

## Vegetable

**Objectives:**

- Development of high yielding, drought tolerant varieties of peas (*Pisum sativum*) and tinda (*Praecitrullus fistulosus*) for Pothowar region
- Standardization of Production technology of different vegetables under climate change scenario

**Kharif 19-2020**

During Kharif 2019, six experiments were conducted by vegetables section of BARI Chakwal. Three experiments were conducted on chillies whereas one experiment each was conducted on tinda, onion and bitter gourd.

**1.Maintenance of chilli (*Capsicum annum*) germplasm**

Twenty genotypes collected from different sources were sown in nursery beds on 30-12-2018 and transplanting was done on 04-03-2019 in observational rows of 7 x 1.5 m long. The plant to plant and row to row distances were maintained as 45 x 75 cm. respectively. Normal agronomic practices and necessary plant protection measures were adopted during the crop season.

The performance of newly collected lines Jalapino and Desi were satisfactory. But the remaining new lines were highly infested with disease and showed high rate of mortality in the field. Five true to type plant from best performing ten genotypes were collected for further maintenance. Data was recorded for six morphological parameters. Variations observed among twenty genotypes are mentioned in table 43.

**Table 43: Range of different morphological parameters of chillies germplasm**

| Sr.No | Traits | Min | Max |
|---|---|---|---|
| 1 | Plant height (cm) | 60 | 125.9 |
| 2 | Days to flower initiation | 41 | 49 |
| 3 | No. of Primary branches | 7 | 16 |
| 4 | No. of Secondary branches | 6 | 18 |
| 5 | Fruit length (cm) | 2.6 | 5.3 |
| 6 | Yield per plant(g) | 393.9 | 2239.2 |

**2.Genetic improvement through hybridization of chillies**

Genotypes: Parents = (Mirchola, China, Desi and Jalapino) were shifted in field 05-03-2019 in observational rows of 7 x 1.5m long. The plant to plant and row to row distances were maintained as 45 x 75 cm. respectively. Normal agronomic practices and necessary plant protection measures were adopted during the crop season.

Total 48 flowers were attempted in all cross combinations to develop $F_0$ generation from 1$^{st}$ week of April to mid May, 2019. But only 8.3% fruit setting could be achieved. Seed of two combinations (Mirchola x Jalapino, Mirchola x Desi ) having two fruits each were harvested, dried, packed and labelled.

**3.Effect of different NPK fertilizer dose on growth and yield of chilli**

A field study was carried out to find out a standard fertilizer dose for four chilli genotypes (V1= Mirchola, V2= Jalapino, V3= Desi and V4= China) in pothowar conditions. The study was conducted on a sandy loam soil low in organic matter (0.52 %) with extractable K (120 mg/kg), extractable P (3.5 mg $kg^{-1}$) and a soil pH of

8.0. Fertilizer doses are given in detail in the table below. The crop was transplanted on 14-03-2019, using split plot Design with three replications and a net plot size of 9m$^2$. The crop harvesting was started in June and ends in July 2019. The seed yield was recorded and analyzed statistically.

Different doses of fertilizer affected the seed yield of genotypes differently. Mirchola and China genotypes produced higher average yield when 110-90-70 Kg NPK/ha was applied. Whereas higher yield of Jalapino and Desi chilli was found when 120-100-10 Kg NPK/ha was applied (Table 44).

**Table 44: Effect of different fertilizer dose on seed yield of chillies**

| S.No. | Fertilizer dose(N-P-K) kg /ha | **Seed yield (kg/ha)** | | | |
|---|---|---|---|---|---|
| | | **Mirchola** | **Jalapino** | **Desi** | **China** |
| 1 | 0-0-0 | 750 | 1295 | 835 | 590 |
| 2 | 125-75-60 | 1200 | 2340 | 1526 | 1120 |
| 3 | 110-90-70 | 1240 | 2400 | 1550 | 1146 |
| 4 | 120-100-80 | 1230 | 2356 | 1510 | 1140 |
| 5 | 120-100-100 | 1223 | 2516 | 1613 | 1085 |
| **LSD $_{0.05}$ =** 15.59,CV % = 8.4% | | | | | |

**4.Evaluation of tinda (*Praecitrullus fistulous*) germplasm under rainfed conditions in Chakwal**

Two collections of Tinda Gourd genotypes along with check variety Dilpasand were evaluated for yield under rainfed conditions in Chakwal. Crop was sown on 24-04-2019 according to RCBD design in three replications. The plot size 6m x 2.5m having P x P = 30cm was maintained for each genotype in all replications. Normal agronomic practices and necessary plant protection measures were adopted during the crop season. Harvesting was started in 1$^{st}$ week of June and continued till end of July. Yield data recorded is as follows in Table 45: -

**Table 45: Yield study of different tinda germplasm under rainfed conditions in Chakwal**

| Sr No | Entries | Average Yield ( Kg/Acre) |
|---|---|---|
| 1 | 19BT001 | 1245 |
| 2 | 19BT002 | 1040 |
| 3 | Dilpasand | 1180 |

Average yield of 19BT001 showed 6% higher yield than our check variety Dilpasand.

**5.Growth analysis of onion (*Allium cepa*) under different irrigation regimes**

A trial was conducted to evaluate onion varieties under different irrigation regimes during Kharif 2019. Two genotypes i.e. Phulkara and Swat-1 were evaluated under 3 irrigation regimes (T1= No irrigation, T-2= 50% irrigation, T-3 = 100% Irrigation). Both varieties were sown in nursery beds on 14-05-2019 and transplanting were done on 22-07-2019 following split-plot design. In each treatment 100 plants of each variety were transplanted. Normal agronomic practices and necessary plant protection measures were adopted during the crop season. Irrigation was applied to all varieties and treatments after transplantation. Crop was harvested and yield data recorded for 20 bulbs from each treatment were as follows in Table 46:-

**Table 46: Effect of different irrigation regimes on yield of onion varieties**

| Treatments | Average Yield ( Kg/plot) | |
|---|---|---|
| | **Phulkara** | **Swat-1** |
| No irrigation | 3.0 | 3.25 |
| 50% Irrigation | 4.82 | 5.23 |
| 100% Irrigation | 5.60 | 6.24 |
| **LSD $_{0.05}$ =** 0.6, | | CV % = 6.54 |

Keeping in view, the scarcity of water in world as well as in Pothowar the performance of Swat-1 under no irrigation was found economical (Figure 5). As onion prices are very high during October and November. Bulbs of Swat-1 and Phulkara having small neck diameter and bulb weight (> 80g) were sown in isolation

for true to type seed production. Further studies are required to ensure stable yield and seed produced will be sown during Kharif 2020.


Phulkara. No irrigation


Phulkara. 50% irrigation


Phulkara. 100% irrigation


Swat 1. No irrigation


Swat 1. 50% irrigation


Swat 1. 100% irrigation

**Fig 5: Effect of different irrigation regimes on yield of onion varieties**

**6.Morphological characterization of bitter gourd (*Momordica charanita*) germplasm**

To evaluate/ maintain the bitter gourd germplasm, three collections coded were sown on 15-03-2019 in the observational plots in a plot size measuring 7.0 x 2.5 m. Sowing was done in wattar condition. All standard agronomic and plant protection

measures were practiced. The open pollinated germplasm was maintained through sib-mating. Variations observed during the study are as follow in Table 47:-

**Table 47: Range of different morphological parameters of bitter gourd germplasm**

| Sr.No | Traits | Min | Max |
|---|---|---|---|
| 1 | Nodes for pistillate flower | 8 | 12 |
| 2 | Single fruit weight (g) | 40 | 85 |
| 3 | Fruit length (cm) | 04 | 13 |
| 4 | Fruit width (cm) | 05 | 09 |
| 5 | Yield (g) | 800 | 1745 |


**Fig 6: Different bittergourd germplasm planted in vegetable section of BARI Chakwal**

**RABI 2019-2020**

**7.Maintenance and characterization of garlic (*Allium sativum*) germplasm**

Six different genotypes ( NARC G-1, Desi White, Desi Gulabi, AJK, Iranian, China) of garlic were planted to evaluate their performance in Pothowar region. Area of a plot was 5.4 $m^2$. Row to row spacing was 25 cm and plant to plant was 10 cm. sowing was done in Mid of September. All recommended cultural practices were carried out. Data of Six morphological traits (leaf length, leaf width , Bulb Diameter, No. of cloves per bulb, single bulb weight and Average Yield) were recorded.

Germplasm showed variations in all recorded morphological traits (Table 48 and Figure 7).

**Table 48: Range of different morphological parameters of garlic germplasm**

| Sr.No | Parameter Recorded | Range |
|---|---|---|
| 1 | Leaf Length (cm) | 25-36 |
| 2 | Leaf Width (cm) | 03-07 |
| 3 | Average Single Bulb Diameter (cm) | 3.9-5.7 |
| 4 | Average Single Bulb Weight (g) | 38-178 |
| 5 | No. of cloves per bulb | 06-23 |
| 6 | Average bulb yield of 10 plants (Kg) | 1.15-2.65 |

Leaf Length was found Maximum in AJK line i.e. 36cm. Whereas NARC G-1 Showed maximum leaf width ( 07cm) , Bulb diameter (5.7cm), Single Bulb Weight ( 178g) and Yield (2.65Kg in 10 plants). Desi white line showed higher cloves per bulb i.e. 29.


**Fig 7: Different garlic germplasm planted in vegetable section of BARI Chakwal**

**8.Effect of gypsum application on yield in garlic (Gulabi Lehsan)**

An experiment was conducted to increase yield of Gulabi Lehsan by using Gypsum Application. Plot size for each treatment was 270ft$^2$. Two treatments (5Kg, 10 Kg) and one control was used in experiment. Sowing was done on 15-09-2019. All recommended agronomic practices were adopted. Data was recorded and analyzed in Table 49: -

**Table 49: Effect of different gypsum application on growth parameters of garlic**

| Treatment | Dose | Bulb Diameter(cm) | No. of Cloves/bulb | Average Single Bulb Weight (g) | Yield per plot (Kg) |
|---|---|---|---|---|---|
| $T_1$ | Control | 4.1 | 23 | 40 | 7.4 |
| $T_2$ | 5Kg/plot | 4.9 | 27 | 49 | 8.5 |
| $T_3$ | 10Kg/plot | 4.6 | 24 | 44 | 8.2 |

Positive results were obtained from Gypsum application on Gulabi Lehsan. Highest yield (8.5 Kg) was found from $T_2$ (5Kg/plot). Beside yield, gypsum application has improved Bulb diameter and No. of cloves per bulb as compared to control.

**9.Maintenance and characterization of pea (*Pisum sativum*) germplasm**

Pea germplasm comprising of 30 lines from diversified genetic background were studied. Sowing was done on 18-10-2019. Two rows were grown for each entry. Recommended crop management practices were adopted. Data of agronomic traits were recorded. Variations in traits are given in table 50 below.

**Table 50: Range of different morphological parameters of pea germplasm**

| Sr. No. | Characters Studied | Range |
|---|---|---|
| 1- | Plant Height (cm) | 25-120 |
| 2- | No of pods per plants | 18-38 |
| 3- | Seeds per pod | 05-12 |
| 4- | Days to flowering | 35-65 |
| 5 | Days to maturity | 75-105 |
| 6 | Average yield per plant (Kg) | 0.8 – 2.1 |

**Fig 8: Different pea germplasm planted in vegetable section of BARI Chakwal**

**10.Crossing Block of pea germplasm:**

To create genetic diversity in desirable recombinants, 06 entries from different sources were sown on three different dates at 10 days interval to synchronize flowering time for making fresh crosses between parental lines. Following Line x Tester design 08 crosses were planned. Around 100 attempts were made to develop 08 crosses. At maturity two crosses were successfully collected, labelled and stored for next season.

**11.Station Yield Trial of Pea Under Rainfed Conditions of Pothowar**

Six promising lines were evaluated for their yield performance against two check varieties i.e., FSD-09 and Meteor. The trial was planted on 18-10-2019 following Randomized Complete Block Design with three replications keeping a plot size of 3m x 0.67m . The rows were kept 45 cm apart. Fertilizer was applied @ 25-35-30 NPK Kg/ha respectively. The harvesting of trial was started on 05-02-2020. The yield data were recorded analysed statistically and is given in Table 51 below:

**Table 51: Average Yield Performance of Entries included in Station Yield Trial 2019-20**

| Entry | V. Code | Average (Kg/Ha) | Entry | V. Code | Average (Kg/Ha) |
|---|---|---|---|---|---|
| 1 | 18B001 | 2200 | 05 | 19B005 | 2235 |
| 2 | 18B002 | 2272 | 06 | 19B006 | 2395 |
| 3 | 18B003 | 3450 | 07 | FSD-09 | 2457 |

| | | | | | |
|---|---|---|---|---|---|
| 4 | 19B004 | 3199 | 08 | Meteore | 2198 |

Significant differences were found among the test entries for their yield performance. Two genotypes gave higher yield than both check varieties FSD-09 and Meteore. Highest average yield was 3450 Kg/ha from 18B003 followed by 19B004 (3199 Kg/ha). The lowest yield of 2198 Kg/ha was obtained from the check variety Meteor.

**12.Multi-locational Trials of 18B003 under rainfed conditions of Pothowar**

A candidate line 18B003 was evaluated at four different locations (Chakwal, Attock, FatehJang and Islamabad) for their yield performance against a check variety i.e., FSD-09. The trial was sown on 15-10-2019. Plot size was kept 272ft2. The rows were kept 45 cm apart. Fertilizer was applied @ 25-35-30 NPK Kg/ha respectively. The harvesting of trial was started on 15-01-2020. The average yield data recorded from four locations is given in Table 52 below: -

**Table 52: Average Yield Performance of pea advanced line (18B003) in Multi-locational Yield Trial 2019-20**

| Sr. No | Location | Average yield (Kg/ha) | |
|---|---|---|---|
| | | 18B003 | FSD-09 (Check) |
| 1 | Chakwal | 3480 | 2331 |
| 2 | Attock | 3445 | 2605 |
| 3 | FatehJang | 3383 | 2420 |
| 4 | Islamabad | 3510 | 2736 |

**13.Sowing date studies of Advance line 18B003:**

A field study was carried out to find out an optimum date of sowing for new promising lines of Pea (18B003) under rainfed conditions. The crop was sown on October 15, 2019, using RCB Design with three replications and a net plot size of 3 m x 0.67 m. The crop harvesting was started from 15-01-2020. The yield was recorded and analyzed statistically as shown in Table 53 below: -

**Table 53: Performance of pea advanced line (18B003) at different sowing dates**

| Treatment | Sowing Date | Germination (%) | Plant height (cm) | No of pods/plant | Yield (kg/ha) |
|---|---|---|---|---|---|
| D-1 | 1-10-19 | 35% | 55 | 35 | 1864 |
| D-2 | 15-10-19 | 93% | 62 | 42 | 3412 |
| D-3 | 30-10-19 | 78% | 50 | 28 | 2156 |

Crop planted on 01-10-2019 was severely affected by Fusarium wilt. Higher yield (3412 Kg/Ha) was obtained from D-2, 15-10-2019. Whereas D-3 was affected by frost and produced very less pods i.e. 28 and hence lesser yield.

**14.Effect of different doses of Fertilizer on Growth and Yield of Advance line 18B003**

A field study was carried out to find out an optimum fertilizer dose for new promising lines of pea (18B003) under rainfed conditions to increase fertilizer use efficiency. The study was conducted on a sandy loam soil low in organic matter (0.59 %) with extractable K (110 mg/kg), extractable P (4.2 mg kg-1) and a soil pH of 8.1.Fertilizer doses are given in detail in the table 54 below. The crop was sown on October 15, 2019, using RCB Design with three replications and a net plot size of 3 m x 0.67 m. The crop harvesting was started from 15-01-2020. The yield was recorded and analyzed statistically.

**Table 54: Performance of pea advanced line (18B003) at different fertilizer dose**

| S. No. | N kg/ha | P kg/ha | K kg/ha | Average yield (kg/ha) |
|---|---|---|---|---|
| | | | | 18B003 |
| 1 | 0 | 0 | 0 | 2225 |
| 2 | 20 | 35 | 30 | 2810 |
| 3 | 20 | 35 | 35 | 2915 |
| 4 | 25 | 35 | 30 | 3410 |
| 5 | 25 | 40 | 30 | 2745 |

Results showed variations in yield under different doses of fertilizer application. The highest yield (3410 kg/ha) was recorded with (25-35-30 kg NPK/ha. All other fertilizer treatments showed positive response in yield as compared to control treatment.

**15.Incidence of *Fusarium wilt,* downy mildew and powdery mildew in pea promising line (18b003) under natural medium rainfall conditions of Chakwal**

A field experiment was conducted to screen pea advance line for resistance to three different diseases (Powdery mildew, Downy mildew and *Fusarium wilt*). Data about disease incidence were recorded after every rainfall. Advance life of pea (18B003) was found susceptible to fusarium wilt but showed tolerance to both powdery and downy mildew.

**Horticulture**

Horticulture section is doing research on a number of high value fruits of deciduous and evergreen nature. These fruits include Grapes, Peaches / Nectarines, Citrus, Date Palm, Avocado, Fig, pear, plum, persimmon, pistachio, apricot, passion fruit and different berries. Three varieties of grapes (Sultanina, BARI Grape-1 and Sugra-1) were got registered with Federal Seed Certification and Registration Department during the year under report. Fifteen thousand (15,000) certified nursery plants of grapes varieties were produced for distribution among the grape's growers of the region.

During 2019-20, a five-year ADP Project titled "Introduction and Adaptation of High Value Crops and Fruits in Climatic Conditions of Punjab" has been completed in which nine high value fruits were introduced to evaluate their adaptability in Punjab. Among these fruits, grapes, peaches / nectarines, fig and black berries started fruiting during Project period and found as potential high value fruits for commercial plantation in Punjab after comprehensive R&D work. So, these fruits will be available for commercial scale plantation in near future. Similarly, a new four years ADP Project titled "Promotion of Fruits Production in Punjab through Provision of Certified Plants" has also been executed by the Horticulture section under able leadership of Dr. Muhammad Ijaz, Director BARI, Chakwal. During this Project certified plants of Grapes, Peaches and Fig will be produced and provided to the registered nursery growers of Punjab.

**Objectives:**

- To find out the suitable varieties of fruit crops for agro-climatic conditions of Pothowar region
- To improve fruit yield and quality of fruit crops of the region
- To widen the varietal spectrum of high value fruit crops in relevance of their suitability in Punjab
- To evaluate the suitable varieties for commercial cultivation in agro climatic conditions of Pothowar region
- Registration of New High Value Fruit Varieties for production of certified nursery plants

**1.Performance of grape varieties in Pothowar region**

The experiment was conducted to observe the performance of 24 varieties of grapes. Plantation was done at a plant to plant distance of 6ft. and line to line distance 10ft. Recommended doses of fertilizer were applied and plant protection measures were adopted. Performance of the varieties was evaluated on the basis of following parameters including Fruit Yield (kg)/plant, Berry weight, Berry size, Cluster weight, Acidity, TSS, Color and Taste etc.

Highest yield (12.65 kg/ plant) was recorded in Sultanina, which was followed by Sugra-1 with a yield of 11.35 kg/ plant. Red globe had the highest berry weight (41.5 g), followed by Sultanina (39.4 g). Time of ripening ranged from mid June to mid July in different varieties. As far as taste is concerned, all the varieties remained medium to good except one i.e. Taifi, which was poor in taste. Characteristics of different grape varieties have been given in Table 55.

**Table 55. Fruit characteristics of different grape varieties under Pothowar conditions**

| Variety | Cluster Wt.(g) | Berry Size(cm) | No. of Seeds/berry | 10Berry Wt.(g) | No. of Clusters/p | Time of Ripening | Yield/P (Kg) | T.S.S. | Acidity (%) | Color | Taste |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sultanina** | **372.25** | 2.57 | Seedless | 39.4 | 34 | End June | **12.65** | **19.0** | .31 | Yellowish Green | Good |
| **Vitro Black** | 355.40 | 2.30 | Seedless | 33.7 | 29 | End June | 10.30 | 18.4 | .32 | Dark Purple | Good |
| **Sugra-1** | 315.50 | 2.20 | Seedless | 33.2 | 36 | Start July | **11.35** | 18.8 | **.29** | Yellowish Green | Good |
| **Kings Ruby** | 278.90 | 1.81 | Seedless | 23.8 | 28 | End June | 7.80 | 18.6 | .31 | Dark Purple | Good |
| **Regenia** | 265.32 | 2.79 | 2-3 | 38.2 | 30 | Mid June | 7.95 | 18.2 | .33 | Light Purple | Medium |
| **Flame Seedless** | 280.45 | 2.01 | Seedless | 24.9 | 32 | Mid June | 8.97 | 18.8 | .32 | Light Purple | Good |
| **Priest** | 80.10 | 1.93 | 3-4 | 23.1 | 40 | Mid June | 3.20 | 18.4 | .34 | Black | Medium |
| **Flame Tokay** | 312.20 | 1.99 | Seedless | 21.5 | 29 | Mid June | 9.05 | 18.5 | .34 | Light Purple | Good |
| **Thompson Seedless** | 230.50 | 1.50 | Seedless | 14.8 | 32 | End June | 7.37 | 18.4 | .36 | Yellowish Green | Good |
| **Haita** | 340.36 | 2.22 | 2-3 | 34.2 | 17 | Mid July | 5.78 | 16.4 | .39 | Fresh Green | Medium |
| **Chasselas** | 172.60 | 1.31 | 3-4 | 12.6 | 55 | Start July | 9.49 | 18.0 | .36 | Dark Green | Medium |
| **Perlette** | 275.80 | 1.72 | Seedless | 19.2 | 28 | Mid June | 7.72 | 19.0 | .29 | Yellowish Green | Good |
| **Red Globe** | 287.25 | 2.92 | 2-3 | 41.5 | 13 | Mid July | 3.73 | 18.6 | .36 | Pink Green | Medium |
| **Kishmish** | 182.38 | 1.50 | Seedless | 13.1 | 26 | Mid July | 4.74 | 18.2 | .37 | Light Green | Medium |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sahebi** | 258.42 | 2.22 | 2-3 | 30.2 | 18 | Mid July | 4.65 | 17.4 | .39 | Yellowish Green | Medium |
| **Danlas** | 354.20 | 2.01 | 2-4 | 27.5 | 30 | Mid July | 10.62 | 18.8 | .34 | Green | Good |
| **Early White** | 262.65 | 2.20 | Seedless | 35.2 | 31 | Mid June | 8.14 | 18.7 | .31 | Yellowish Green | Good |
| **Italia** | 320.15 | 2.45 | 2-3 | 33.6 | 25 | Mid July | 8.00 | 17.8 | .38 | Yellowish Green | Medium |
| **Muscat Humbourg-** | 286.32 | 2.15 | 2-3 | 24.1 | 38 | Mid July | 10.88 | 19.2 | .32 | Black | Good |
| **White Seedless** | 270.84 | 1.70 | Seedless | 16.4 | 30 | Mid June | 8.12 | 18.0 | 0.34 | Yellowish Green | Good |
| **China-5** | 271.60 | 2.95 | 2-3 | 37.8 | 21 | Start July | 5.70 | 17.8 | 0.35 | Yellowish Green | Good |
| **Gol** | 218.85 | 1.52 | Seedless | 14.3 | 18 | Mid July | 3.93 | 18.0 | 0.34 | Yellowish Green | Medium |
| **Taifi** | 310.54 | 2.93 | 2-3 | 37.6 | 18 | Mid July | 5.58 | 17.6 | 0.36 | Yellowish Green | Poor |
| **China-3** | 265.40 | 2.24 | 2-3 | 34.3 | 23 | Start July | 6.10 | 17.0 | 0.38 | Yellowish Green | Medium |

**2.Effect of Gibberellic Acid on fruit yield and quality of Sultanina grapes**

Trial was conducted to improve the fruit yield and quality of the grape variety 'Sultanina'. Four treatments of Gibberelic Acid (Control, 100 mg/liter, 200 mg/liter and 300 mg/liter) were used. Recommended doses of fertilizer were applied and plant protection measures were also adopted. Gibberellic acid was sprayed twice. 1st spray was applied at full bloom stage and 2nd spray after one week of the 1st spray. Randomized Complete Block Design was used with three replications.

Effect of different treatments was observed on cluster weight, berry weight, berry size, TSS, acidity and taste of fruit. Maximan berry size (2.85 cm) and highest berry weight of 10 berries (40.9 g) as well as highest cluster weight (387.5 g) was observed in case of T4 (300 mg/liter). On the other hand taste remained medium in case of this treatment. The treatment T3 (200 mg/liter) was second to T4 in case of berry size, berry weight and cluster weight and had a good taste (Table 56).

**Table 56. Effect of Gibberelic acid on Physico-Chemical Characteristics of Grapes**

| Variety | Treatment | Cluster Wt.(g) | 10Berry Wt.(g) | Berries/Cluster | Berry Size(cm) | T.S.S. | Acidity | Taste |
|---|---|---|---|---|---|---|---|---|
| Sultanina-C | T1 (control) | 257.2 | 24.9 | 125.20 | 1.83 | 19.0 | 0.32 | Good |
| | T2 (100 mg/liter) | 278.0 | 30.7 | 114.25 | 1.98 | 18.8 | 0.31 | Good |
| | T3 (200 mg/liter) | 345.4 | 36.2 | 102.25 | 2.32 | 18.6 | 0.31 | Good |
| | T4 (300 mg/liter) | 387.5 | 40.9 | 95.50 | 2.85 | 18.0 | 0.32 | Medium |
| CV at 5% | | 11.95 | 8.24 | 10.32 | 1.92 | 1.85 | 5.60 | |

**3.Effect of Boron on yield and quality of grapes**

To observe the effect of Boron application on yield and quality of Sugra-1 variety of grapes, trial was conducted under Randomized Complete Block Design using four treatments, which included T1 (control), T2 (0.1% Boric Acid foliar application) T3

(0.2% Boric Acid foliar application) and T4 (0.3% Boric Acid foliar application). Application of two foliar sprays of different concentrations of Boric Acid (H3BO3) was carried out 1 week before and 1 week after full bloom. Data was collected for berry size, berry weight and fruit yield/plant. Normal cultural practices, such as pruning, weed control will be uniformly performed. Data given in Table 3 shows that highest values for cluster weight, berry size, berry weight, No. of clusters / plant and yield/plant was observed in T4. TSS was highest in case of T2, while control gave the highest value for acidity

**4.Performance of citrus varieties under agro climatic conditions of Chakwal**

To observe the performance of eight varieties of citrus under the agro climatic conditions of Chakwal, trial was laid out under Randomized Complete Block Design with three replications. Bud wood/ budded plants of Citrus varieties were collected from CRI, Sargodha and plants were prepared/ planted in field. Rough Lemon was used as root stock. Data was collected regarding Fruit yield (kg), fruit weight, juice percentage, peel weight, fruit TSS, acidity etc shown in Table 57 and 58 below:-

.

**Table 57: Effect of Boron application on fruit characteristics of Sugra-1 variety of grapes**

| Variety | Treatment | Cluster Wt.(g) | Berry Size(cm) | 10Berry Wt.(g) | No. of Clusters/p | Yield/P (Kg) | T.S.S. | Acidity (%) | Color | Time of Ripening | Taste |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sugra-1** | **T1** | 234.00 | 1.97 | 29.7 | 23 | 7.25 | 18.6 | **0.29** | Yellowish Green | Mid June | Good |
| | **T2** | 253.25 | 2.12 | 31.5 | 28 | 9.65 | **19.0** | 0.31 | Yellowish Green | End June | Good |
| | **T3** | 267.4 | 2.06 | 34.8 | 32 | 10.15 | 18.4 | 0.34 | Yellowish Green | End June | Good |
| | **T4** | **296.32** | **2.18** | **38.2** | 34 | **11.66** | 18.2 | 0.36 | Yellowish Green | Start July | Good |
| **CV at 5%** | | 13.76 | 2.12 | 10.32 | 9.70 | 7.65 | 1.97 | 5.90 | | | |

**Table 58: Physico-Chemical Characteristics of citrus Fruit**

| Variety | Fruits per Plant | Ave. Fruit Weigh(g) | Fruit Size (cm) | Ave yield/plant (kg) | Seeds /Fruit | Peel Weight (g) | Juice %) | TSS | Acidity %) |
|---|---|---|---|---|---|---|---|---|---|
| **Salustiana** | 385.5 | **251.8** | 6.70 | **97.06** | **1.8** | 58.10 | **48.25** | 11.50 | 0.41 |
| **Blood Red** | 375.0 | 175.2 | 5.94 | 65.70 | 12.0 | 61.15 | 43.32 | 10.20 | 0.57 |
| **Cassa Grande** | 368.5 | 229.2 | 6.15 | 84.46 | 9.1 | 72.24 | 40.60 | 11.10 | 0.42 |
| **Parson Brown** | 335.0 | 242.5 | 6.54 | 81.23 | 6.4 | 70.62 | 39.02 | 10.70 | 0.40 |
| **Morro** | 358.0 | 204.8 | 6.17 | 73.35 | 5.5 | 62.19 | 46.10 | 10.40 | 0.56 |
| **Tarocco** | 330.2 | 220.2 | 6.54 | 72.71 | 2.0 | 76.14 | 45.25 | 10.50 | 0.43 |
| **Musambi** | 398.0 | 188.4 | 6.10 | 74.98 | 16 | 65.32 | 41.58 | 10.20 | 0.42 |
| **Succari** | **460.0** | 165.5 | 5.92 | 76.13 | 22 | 63.57 | 40.15 | **12.10** | 0.23 |
| **CV at 5%** | 14.56 | 8.35 | 1.75 | 10.65 | 18.04 | 10.22 | 8.25 | 1.85 | 5.12 |

**5.Performance of different varieties of peach in Pothowar climate**

Trial was conducted to observe the performance of six varieties of peach under the climatic conditions of Pothowar. Randomized Complete Block Design was used with four replications. Data recorded regarding different parameters is shown in Table 59. Highest yield (29.10 kg per plant) and maximum fruit weight (172.25 g) was observed in Early Grand. It was followed by Florida King with a yield of 23.50 kg per plant and fruit weight of 162.80 g. Harvesting time of both these varieties was earlier than other varieties.

**Table 59: Performance of different varieties of peach under climatic conditions of Pothowar**

| Variety | Yield/P (kg) | Fruit Wt.(g) | Fruit Size(cm | Stone Wt.(g) | Stone Size(cm) | T.S.S. | Acidity | Harvesting Time |
|---|---|---|---|---|---|---|---|---|
| **Early Grand** | **29.10** | **172.25** | 7.32 | 7.9 | 1.90 | 11.8 | 0.36 | End May |
| **Florida King** | 23.50 | 162.80 | 7.21 | 7.6 | 1.80 | **12.2** | 0.35 | End May |
| **Micholae** | 21.90 | 105.25 | 4.70 | 7.4 | 1.63 | 10.2 | 0.75 | End May |
| **Florida Gold** | 20..15 | 124.50 | 5.82 | 6.7 | 1.53 | 12.0 | 0.40 | Mid June |
| **Texas-Y-455** | 16.25 | 147.65 | 6.85 | 7.2 | 1.65 | 11.2 | 0.42 | Mid June |
| **A-669** | 20.50 | 148.20 | 6.49 | 6.5 | 1.60 | 11.7 | 0.41 | Mid June |
| **CV at 5%** | 18.05 | 10.72 | 12.65 | 10.02 | 9.72 | 1.63 | 3.97 | |

**6.Effect of foliar application of Boron on yield and quality of peaches**

Trial was conducted to observe the effect of foliar application of Boron on yield and quality of Early Grand variety of peaches. Trial was conducted under Randomized Complete Block Design using three treatments, which included T1 (control), T2 (0.1% Boric Acid foliar application) T3 (0.2% Boric Acid foliar application) and T4 (0.3% Boric Acid foliar application).

Application of foliar spray of different concentrations of Boric Acid was carried out at flowering and 15 days after fruit set. Data was collected for fruit size, fruit weight, stone weight, pulp weight, pulp/stone ratio and fruit yield/plant. Normal cultural practices, such as pruning weed control were uniformly performed. Data given in Table 60 shows that highest values of fruit weight, fruit size and fruit yield were found in case of T4 (0.3% Boric Acid foliar application). Harvesting time in case of T3 and T4 was also earlier (Mid May), which helps in getting good rates in the market.

**Table 60: Effect of Boron application on yield and quality of peaches**

| Variety | Treatment | Fruit Wt. (g) | Fruit Size (cm | Stone Wt. (g) | Stone Size (cm) | T.S.S. | Acidity | Yield/P (kg) | Harvesting Time |
|---|---|---|---|---|---|---|---|---|---|
| **Early Grand** | **T1** | 156.20 | 6.54 | 6.89 | 1.65 | 11.0 | 0.41 | 16.54 | End May |
| | **T2** | 159.00 | 7.19 | 7.25 | 1.74 | 11.5 | 0.39 | 20.70 | End May |
| | **T3** | 165.32 | 7.35 | 7.58 | 1.87 | 11.7 | 0.38 | 22.95 | Mid May |
| | **T4** | **172.50** | 7.45 | 7.70 | 1.92 | **12.0** | 0.37 | **28.50** | Mid May |
| **CV at 5%** | | 12.65 | 9.84 | 10.52 | 2.14 | 1.15 | 2.52 | 12.32 | |

**CEFORT at BARI, Chakwal**

Presently, there is very little availability of local olive products in the market. There are only a couple of small-scale private sector entities involved in processing packaging olives and olive oil for local market consumption. Local R&D will not only help existing farmers but also encourage others to make use of their marginal lands in a profitable manner. In addition, this will also contribute towards decreasing the country's dependence on imported olive oil and save precious foreign exchange.

Olive being a new crop in the country and there is need to create a sustainable enabling environment for the growers and other stakeholders. Meanwhile, existing research facilities in the sector are limited and increase of business in the said sector will require more extensive research facilities coping with issues and constraints of newly developed business and research. Establishment of a dedicated centre for olive research and training will help generate indigenous datasets to support R&D developments in the province on sustainable basis. It can ensure high standards in research, training, innovation and learning across entire olive value chain.

Olive section/CEFORT section is doing research on olive. During 2019-20, a three-year ADP Project titled “Centre of Excellence for Olive Research and Training” under process in which different olive varieties were introduced to evaluate their adaptability in Punjab. Among the different olive verities during Project period and found as potential high value fruits for commercial plantation in Punjab. So, Olive will be available for commercial scale plantation in near future. Currently the team visited the southern Punjab Districts for olive adaptability trials and train the farmers during Aug and distribute plants during October, 2020.

**Objectives:**

- Evaluation of the optimum level of nitrogen as growth retardant to suppress growth of olive for yield improvement
- To find out the suitable dose of paclobutrazol to suppress the vegetative growth and increase the yield of olive.
- Effect of potassium nitrate (kno3) on fruiting behavior of olive
- Standardization of optimum dose of sodium selenate to get quality olive fruit and oil.

**1. Application of Urea as Growth Retardant in Olive Under Pothowar Conditions**

The experiment was conducted to observe the performance of BARI Zatoon-I olive variety. Plantation was done at a plant to plant distance of 6ft. and line to line distance 10ft. Recommended doses of fertilizer were applied and plant protection measures were adopted.P erformance of the varieties was evaluated on the basis of following parameters including Fruit Yield (kg)/plant, Berry weight, Berry size, Cluster weight, Acidity, TSS, Color and Taste etc.

Urea was sprayed on BARI Zatoon-I as mentioned in following treatment list during the month of November. Ureae was applied @ of 6 %, 7 %, 8 %, 9% and 10%. The design was RCBD, each treatment replicated three times and the age of plants were 8-10 years. It was observed that maximum average number of new shoots/branch of BARI Zatoon-I were observed by applying Urea @ 9% while average length of sprouted shoot, fruit setting % and fruit yield per plant was (19.43cm), (1.51%) and (26.08) respectively by applying urea@ 6%, while maximum flowers initiation (138 date) and anthesis period (7.30 days) were observed in control treatment. So the Urea @ 6% spray solution remained superior during November on BARI Zatoon-I. Characteristics of olive variety have been given in Table 61.

**Table 61. Growth characteristics of different** BARI Zatoon-I **under Pothowar conditions**

| | $T_1$ Control | $T_2$ Urea 6% | $T_3$ Urea 7% | $T_4$ Urea 8% | $T_5$ Urea 9% | $T_6$ Urea 10% |
|---|---|---|---|---|---|---|
| Average no. of New Shoots/Branch | 5.33 | 7.33 | 8.00 | 7.00 | 8.67 | 10.33 |
| Average Length of Sprouted Shoot (cm) | 6.53 | 19.43 | 16.30 | 11.63 | 16.06 | 8.10 |
| Flowers Initiation (date) | 138 | 129.3 | 125.3 | 125.0 | 126.6 | 126.3 |
| Anthesis Period (days) | 7.3 | 6.3 | 5.3 | 5.0 | 4.3 | 4.0 |
| Fruit Setting % | 0.94 | 1.51 | 1.09 | 0.83 | 0.53 | 0.30 |
| Fruit Yield/Plant | 17.73 | 26.08 | 23.90 | 16.78 | 15.16 | 13.24 |

**2.Effect of Paclobutrazol On Growth and Yield of Olive Plant**

Paclobutrazol was sprayed on BARI Zaitoon-2 olive Variety according to the following treatment list in the month of November. Paclobutrazole was sprayed @ 0.05 %, 0.01 %, 0.15 %, 0.20 %, 0.25 % and 0.30 %. . Randomized Complete Block Design was used with three replications. Effect of different treatments was observed on by applying Paclobutrazol on BARI Zaitoon-2. It was observed that there was no significant difference was observed in flower initiation and flower anthesis by applying Paclobutrazol on BARI Zaitoon-2. Maximum fruit Size (2.97cm) and fruit yield/plant (27.55kg) were observed by applying paclobutrazol @ 0.10 % while

maximum number of flowers and fruit drop % were observed by applying paclobutrazol @ 0.30 % in BARI Zatoon-I. So the suitable dose of paclobutrazol to suppress the vegetative growth and increase the yield of olive was the rate of paclobutrazol @ 0.10 % (Table 62).

**Table 62. Effect of paclobutrazol on growth and yield of olive plant**

| | $T_1$ Control | $T_2$ 0.05 % | $T_3$ 0.10 % | $T_4$ 0.15 % | $T_5$ 0.20 % | $T_6$ 0.25 % | $T_7$ 0.30 % |
|---|---|---|---|---|---|---|---|
| Leaf Size (cm) | 1.19 | 1.18 | 1.15 | 1.11 | 1.75 | 1.70 | 1.20 |
| Flower Initiation (days) | 125 | 124 | 121 | 119 | 117 | 114 | 110 |
| Flower Anthesis (days) | 146 | 144.3 | 135.5 | 132.3 | 126.6 | 122.6 | 123.3 |
| No. of Flowers | 379 | 398 | 435 | 446 | 443 | 449 | 493 |
| Fruit Drop % | 21 | 6.6 | 3.3 | 5.6 | 10 | 14 | 17 |
| Fruit Size (cm) | 2.81 | 2.96 | 2.97 | 2.88 | 2.83 | 2.77 | 2.74 |
| Fruit Yield/Plant (kg) | 19.50 | 24.69 | 27.55 | 19.99 | 19.36 | 16.48 | 15.48 |

**3.Effect of Potassium Nitrate ($Kno_3$) On Fruiting Behaviour of Olive**

To observe the effect of $KNO_3$ application on Flower initiation (date), Flower anthesis (days), Flowering %, Fruit volume, Fruit setting %, Fruit drop % and Fruit yield /plant. Potassium nitrate was applied @ 1 %, 2%, 3% 4% and 5%. It was observed that maximum flower initiation, and flowering % were observed by applying 3% potassium nitrate ($KNO_3$) while maximum days for flowering anthesis days (5.30) were recorded in control treatment. Comparing the impact of all treatments the application of 3% potassium nitrate is considered dose optimum dose of potassium nitrate to get economical yield of olive fruit.

**Table 63: Effect of $KNO_3$ application on Flower initiation (date), Flower anthesis (days),**

**Flowering %, Fruit volume, Fruit setting %, Fruit drop % and Fruit yield /plant**

| Treatments | Flower initiation | Flower anthesis (days) | Flowering % |
|---|---|---|---|
| T1 (control) | 126.66 | 5.3 | 38.8 |
| T2 (1%) | 133.00 | 5.0 | 43.7 |
| T3 (2%) | 138.00 | 4.0 | 47.3 |
| T4 (3%) | 143.00 | 3.3 | 50.4 |
| T5 (4%) | 135.00 | 3.6 | 48.6 |
| T6 (5%) | 133.66 | 3.6 | 46.4 |

**4.Effect of sodium selenate on fruit quality of olive**

For standardization of optimum dose of sodium selenate to get quality olive fruit and oil., trial was laid out under Randomized Complete Block Design with three replications. Sodium selenate was sprayed @ 50, 100, and 150 ppm. Randomized Complete Block Design was used with three replications. sodium selenate was applied to chek its effect on Fruit yield /plant and Oil quality of olive. The fruit samples for analysis of Selenium trace element were sent to Nuclear Institute Agriculture and Biology (NIAB) Faisalabad and the results will be received during April, 2020 regarding concentration of Se in olive fruit.

**AGRONOMY**

**Objective**:

- Development of package of production technologies for getting higher yield of existing & new crops and advance lines of wheat, gram, lentil, Brassica, groundnut, mung, mash, sorghum and millet.
- Introduction of new drought tolerant crops to fit in the existing cropping pattern for uplifting the living standards of farming community of the rainfed area.
- Development and utilization of suitable moisture conservation techniques for higher crop return.

- Management of farm and production of true to type seed of various cash crops of the area. Dissemination of production technologies among the farmers of the area

**1.Yield of Wheat Genotypes as Influenced by Different Sowing Dates Under Rainfed Conditions**

A study was conducted to find out the suitable sowing date for new wheat genotypes in order to get maximum grain yield under rained conditions. Five sowing dates from 1st Oct. to 1st Dec. with 15 days interval were studied for five genotypes (16C038, 18C124, 18C116, 18C117 and Barani -17). all cultural practices were same. The data in table 64 revealed that Highly significant differences were found among various sowing dates for grain yield. Wheat crop sown on 15th of November gave the average grain yield of 5503 kg $ha^{-1}$ higher from rest of sowing date treatments. The lowest average grain yield of 2636 kg $ha^{-1}$ was obtained when the crop was sown on 1st of October.

Genotypes did not show significant differences for average grain yield. The average grain yield of 4653 kg $ha^{-1}$ was obtained by cultivar 18C117 which was higher from rest of cultivars. The lowest average grain yield (4387 kg $ha^{-1}$) was obtained by cultivar 16C038.

The interaction of sowing dates and genotypes also showed significant differences for grain yield. The highest average grain yield (5570 $ha^{-1}$) was obtained when genotype Barani-17 was sown on 15th of November. The lowest average grain yield (2363 kg $ha^{-1}$) was recorded when genotype 16C038 was sown on 1st of October.

**Table 64: Grain yield Kg $ha^{-1}$ of wheat as affected by sowing dates and genotypes**

| S. No. | Sowing Dates | Grain yield (kg/ha) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Genotypes | | | | | |
| | | **16C038** | **18C124** | **18C116** | **18C117** | **Barani-17** | **Means** |
| 1 | **1st Oct.2019** | **2363** | 2522 | 2664 | 2870 | 2759 | **2636** |
| 2 | **15st Oct.2019** | 3587 | 3741 | 3902 | 4075 | 4130 | **3887** |
| 3 | **1st Nov.2019** | 5094 | 5419 | 5513 | 5419 | 5470 | **5383** |
| 4 | **15st Nov.2019** | 5375 | 5517 | 5542 | 5511 | **5570** | **5503** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | **1st Dece.2019** | 5316 | 5055 | 5390 | 5390 | 4814 | **5192** |
| | **Mean** | **4387** | **4450** | **4602** | **4653** | **4548** | |
| CV (%) = 8.05.<br>LSD (0.05) for SD = 268.65<br>LSD (0.05) for Var. = 208.94<br>LSD (0.05) for SD x Var. = 600.71 | | | | | | | |

**2.Yield of Lentil as Influenced by Different Sowing Dates and Genotypes Under Rainfed Conditions**

A study experiment was conducted to find out suitable sowing date for new lentil genotypes in order to obtain maximum seed yield under rained conditions. Five sowing dates from 15th September to 15th November at 15 days interval were studied for three genotypes (15CL305, 15CL307 and Ch. Masoor). All cultural practices were kept same. The data in table 65 revealed that Highly significant differences were found among various sowing dates for seed yield. Lentil crop sown on 1th of October gave the average seed yield of 755 kg $ha^{-1}$ higher from rest of sowing date treatments. The lowest average seed yield of 637 kg $ha^{-1}$ was obtained when the crop was sown on 15st of November.

Genotypes also showed highly significant differences for average seed yield. The average seed yield of 708 kg $ha^{-1}$ was obtained by cultivar CH-Masoor which was higher from rest of cultivars. The lowest average seed yield (689 kg $ha^{-1}$) was obtained by cultivar 15Cl307.

As regards the interaction of sowing dates and genotypes, it also showed significant differences for seed yield. The highest average seed yield (778 kg $ha^{-1}$) was obtained when genotype 15CL305 was sown on 15st of October. The lowest average seed yield (566 kg $ha^{-1}$) was recorded when genotype 15Cl307 was sown on 15th of November.

**Table 65: Seed yield of Lentil as affected by sowing dates and genotypes**

| S.No. | Sowing Dates | Seed yield (kg/ha) | | | |
|---|---|---|---|---|---|
| | | Genotypes | | | |
| | | **15CL305** | **15CL307** | **CH.Masoor** | **Means** |
| 1 | **15th Sep.** | 733 | 650 | 661 | 681 |

| | | | | | |
|---|---|---|---|---|---|
| 2 | **1st Oct.** | 727 | 789 | 750 | **755** |
| 3 | **15th Oct.** | **778** | 728 | 711 | 739 |
| 4 | **1st Nov.** | 622 | 716 | 727 | 688 |
| 5 | **15th Nov.** | 650 | **566** | 694 | 637 |
| **Means** | | 702 | 689 | 708 | |
| CV (%) = 11.95<br>LSD (0.05) for SD = 81.405<br>LSD (0.05) for Var. = 96.973<br>LSD (0.05) for SD x Var. = 141.00 | | | | | |

### 3.Response of Different Brassica Cultivars to Sowing Dates Under Rainfed Condition

A study experiment was conducted to find out suitable sowing date for new Brassica genotypes in order to obtain maximum seed yield under rained conditions. Six sowing dates from 1$^{th}$ September to 15$^{th}$ November at 15 days interval were studied for three genotypes (13CBJ004, 11CBN009 and CH. Sarsoon) . All cultural practices were kept same. The data in table 66 revealed the Highly significant differences were found among various sowing dates for seed yield. Brassica crop sown on 1$^{th}$ of October gave the average seed yield of 1172 kg ha$^{-1}$ higher from rest of sowing date treatments. The lowest average seed yield of 733 kg ha$^{-1}$ was obtained when the crop was sown on 1$^{st}$ of September.

Genotypes also showed highly significant differences for average seed yield. The average seed yield of 1201kg ha$^{-1}$ was obtained by cultivar **13CBJ004** which was higher from rest of cultivars. The lowest average seed yield (912 kg ha$^{-1}$) was obtained by cultivar CH Sarsoon.

As regards the interaction of sowing dates and genotypes, it also showed significant differences for seed yield. The highest average seed yield (1205 kg ha$^{-1}$) was obtained when genotype **13CBJ004** was sown on 1$^{st}$ of October. The lowest average seed yield (627 kg ha$^{-1}$) was recorded when genotype CH Sarsoon was sown on 1$^{th}$ of September.

**Table 66: Seed yield of sarsoon as affected by sowing dates and genotypes**

| S.No. | Sowing Dates | Seed yield (kg/ha) | | | |
|---|---|---|---|---|---|
| | | Genotypes | | | |
| | | **13CBJ004** | **11CBN009** | **CH.Sarsoon** | **Means** |
| 1 | **1-9-19** | 805 | 767 | 627 | **733** |
| 2 | **15-9-219** | 918 | 1057 | 953 | **976** |
| 3 | **1-10-19** | **1205** | 1185 | 1125 | **1172** |
| 4 | **15-10-19** | 1056 | 1022 | 997 | **1025** |
| 5 | **1-11-19** | 1076 | 973 | 978 | **1009** |
| | **15-11-19** | 943 | 831 | 860 | **878** |
| **Means** | | **1201** | **1166** | **912** | |
| CV (%) = 09.61<br>LSD (0.05) for SD = 53.6<br>LSD (0.05) for Var. = 24.6<br>LSD (0.05) for SD x Var. = 127.5 | | | | | |

**4.Sowing Date Cum Varietal Trial on Groundnut Under Rainfed Condition**

A study was conducted to find out the most appropriate planting time for new Groundnut lines/strains to get maximum pod yield under rainfed conditions. Five sowing dates from 1$^{th}$ March to 20$^{th}$ May at 20 days interval were studied for two genotypes 13CG003 and Bari -16. All cultural practices were kept same. The data in table 67 revealed that significant differences were found among pod yield for various sowing dates. Groundnut crop sown on 10$^{th}$ April 2019 gave highest pod yield of **3223.3**kg/ha. The lowest pod yield of **2466.5**kg/ha was observed when groundnut crop sown on 1$^{th}$ March 2019.

Genotypes also showed significant differences among the means for pod yield. The Groundnut variety Bari 2016 gave highest pod yield of **3067.00**kg/ha followed by Groundnut promising line **13CG003** producing the pod yield of **2693.00**kg/ha.

The Interaction also showed significant difference among pod yields. The Groundnut variety Bari 2016 gave highest pod yield of **3266** kg/ha when it was sown on10$^{th}$ April 2019 followed by Groundnut promising line **13CG003** producing the pod yield of **3233** kg/ha when it was sown on 30$^{th}$ April 2019.

**Table 67: pod yield (kg ha$^{-1}$) of Groundnut at different sowing dates.**

| Sowing Dates | 13CG003 | Bari2016 | Means |
|---|---|---|---|
| **1$^{st}$ Mar2019** | 2433 | 2500 | **2466** |
| **20$^{th}$ Mar2019** | 2500 | 2933 | **2716** |

| | | | |
|---|---|---|---|
| **10st April 2019** | 3180 | **3266** | **3223** |
| **30th April 2019** | **3233** | 2733 | **2983** |
| **20st May2019** | 2766 | 3033 | **2883** |
| **Means** | **2693** | **3067** | |
| **LSD (0.05) for sowing dates = 337.9** | | | |
| **LSD (0.05) for genotypes = 163.4** | | | |
| **LSD (0.05) for sd x g = 270.16** | | | |
| **CV (%) = 6.97** | | | |

**5.Sowing Date Cum Varietal Trial on Mash Under Rainfed Conditions**

A study was conducted to find out the best sowing time for new mash genotypes for obtaining maximum yield under rainfed conditions. Five sowing dates from 15th June to 25th August at 10 days interval were studied for two genotypes 14CM705 and 14CM708. All cultural practices were kept same. The data in table 68 revealed that Significant differences were found among seed yield for various sowing dates. Mash crop sown on 5th JULY 2019 gave highest seed yield of **595.00** kg/ha. The lowest seed yield of **501.00** kg/ha was observed when mash crop sown on **25st July 2019**.Genotypes also showed significant differences among the means for seed yield. The mash promising line 14CM708 gave highest seed yield of **548.00** kg/ha followed by The mash promising line 14CM705 producing the seed yield of **528.00**kg/ha.

The Interaction also showed significant difference among seed yields. The mash promising line 14CM705 gave highest seed yield of **645.00** kg/ha when it was sown on5th July 2019.

**Table 68: Grain yield (kg ha$^{-1}$) of Mash at different sowing dates.**

| Sowing Dates | 14CM705 | 14CM708 | Means |
|---|---|---|---|
| **15th June2019** | 475 | 551 | **513.00** |
| **25th June2019** | 588 | 500 | **543.00** |
| **05stJuly 2019** | 645 | 543 | **595.00** |
| **15st July2019** | 516 | 560 | **538.00** |
| **25st August2019** | 516 | 488 | **501.00** |

| | | | |
|---|---|---|---|
| **Means** | **528.0** | **548.0** | |
| **LSD (0.05) for sowing dates =50.5**<br>**LSD (0.05) for genotypes = 29.6**<br>**LSD (0.05) for sd x g = 65.6**<br>**CV (%) = 11.0** | | | |

**6.Performance of Hydrogel Doses with Different Application Techniques on Pod Yield of Groundnut Under Rainfed Conditions.**

A study was conducted to find out the best dose of hydrogel and its method of application in Groundnut crop for getting maximum pod yield under Barani areas. Three Hydrogel Doses and three application methods of hydrogel were studied for groundnut crop. All other cultural practices were kept same. The data in table 69 revealed that significant differences were found among various Hydrogel doses for pod yield. Groundnut crop sown with hydrogel doses40 g/m2 gave highest mean pod yield of **2263.0** kg/ha. The lowest pod yield of **1975.0** kg/ha was observed when 30 g/m2 hydro gel doses was used.

Method of application also showed significant differences among the means for pod yield. **Broadcasting Method** gave highest mean pod yield 2139.0 kg/ha followed by **side dressing** method which produce 2099.0 kg/ha

**Table 69: pod yield of Groundnut Kg/ha.**

| **Hydrogel doses** | **Method of application** | | | **Means** |
|---|---|---|---|---|
| | **Drill Application** | **Side dressing** | **Broad casting** | |
| $30gm^{-2}$ | 1975.0 | 2222.0 | 1728.0 | **1975.0** |
| $40gm^{-2}$ | 2222.0 | 2100.0 | 2469.0 | **2263.0** |
| $50gm^{-2}$ | 1975.0 | 1975.0 | 2222.0 | **1999.0** |
| **Means** | **2057.0** | **2099.0** | **2139.0** | |
| **LSD (0.05) for hydro gel doses = 55.8**<br>**LSD (0.05) for Method of application = 44.7**<br>**LSD (0.05) for H g doses x methods = 58.9**<br>**CV (%) = 7.12** | | | | |

## Soil Science

### Objectives

- Standardization of recommended dose of fertilizer for new promising lines of different crops under rainfed conditions
- To study nutrient status of different crops and soil in pothowar region
- To increase fertilizer use efficiency and to improve the soil and overall crop productivity

### 1.Fertilizer Requirements of New Promising Lines of Mash Under Rainfed Conditions

A field study was carried out at experimental field area of Barani Agricultural Research Institute (BARI) Chakwal during 2019.The purpose of this study was to find out a standard fertilizer dose among different doses of fertilizer for new promising mash lines (15CM701 and15CM704) under rainfed conditions. The experiment was laid out in split plot design with three replications and a net plot size of 5 m x 1.2 m. The fertilizer treatments were applied at the time of sowing respectively. The study was conducted on a sandy loam soil low in organic matter (0.52 %) with extractable K (120 mg/kg), extractable P (3.5 mg $kg^{-1}$) and a soil pH of 8.0. Fertilizer doses are given in detail in the table below. The crop was sown on July 25, 2019 and harvested on October 04, 2019. The seed yield was recorded and analyzed statistically (Table 70).

Different doses of fertilizer affected the seed yield differently. Seed yield increased up to 26% as compared to control (no fertilizer addition) in the fertilizer treatment 20-60-30 NPK (kg/ha) The maximum seed yields (987, 978 kg/ha) in these two promising mash lines (15CM701, 15CM704) was recorded respectively where fertilizer dose of 20-60-30 kg NPK /ha was used. It was followed statistically by the treatment 20-90-30 NPK (kg/ha) where seed yield was (885,871 kg/ha) respectively.

### PREVIOUS YEAR'S RESULTS

**Table 70: Effect of Fertilizer Doses on Yield of Mash**

| S. No. | Fertilizer dose (N-P-K) kg /ha | **Advance lines Seed yield (kg/ha)** | |
|---|---|---|---|
| | | **15CM701** | **15CM704** |

| | | | |
|---|---|---|---|
| 1 | 0-0-0 | 727 | 753 |
| 2 | 0-60-30 | 814 | 803 |
| 3 | 20-60-30 | 987 | 978 |
| 4 | 40-60-30 | 897 | 802 |
| 5 | 20-30-30 | 813 | 855 |
| 6 | 20-90-30 | 885 | 871 |
| 7 | 20-60-60 | 816 | 879 |

$LSD_{0.05}$ = 62.9
CV % = 7.81

**Conclusion**

The obtained result depicted that application of fertilizer dose of 20-60-30 NPK kg/ha significantly improve the seed yield of mash.

## 2. Fertilizer Requirements of New Promising Lines of Groundnut Under Rainfed Condition

A field study was carried out at experimental field area of Barani Agricultural Research Institute (BARI) Chakwal during 2019. The objective of this study was to find out an optimum fertilizer dose for new promising lines of groundnut (13CG003) under rainfed conditions to increase fertilizer use efficiency. The study was conducted on a sandy loam soil low in organic matter (0.59 %) with extractable K (110 mg/kg), extractable P (4.2 mg $kg^{-1}$) and a soil pH of 8.1.

Fertilizer doses are given in detail in the table below. The crop was sown on May 19, 2019, using RCBD design with three replications and a net plot size of 5 m x 1.2 m. The crop was harvested on September 26, 2019. The pod yield was recorded and analyzed statistically (Table 71).

Different doses of fertilizer application affected the pod yield differently. The pod yield increased in advanced line. The highest pod yield (1841 kg/ha) was recorded with (20-80-30 kg NPK/ha almost 44 % increase but it was statistically similar with the treatments 20-100-30 kg NPK/ha and 20-120-30 kg NPK/ha. All other fertilizer treatments showed positive response in yield as compared to control treatment.

**PREVIOUS YEAR'S RESULTS**

**Table 71: Effect of fertilizer doses on the pod yield of groundnut**

| S. No. | N kg/ha | P kg/ha | K kg/ha | pod yield (kg/ha) |
|---|---|---|---|---|
| | | | | 13CG0003 |
| 1 | 0 | 0 | 0 | 1034 |
| 2 | 20 | 60 | 30 | 1279 |
| 3 | 20 | 80 | 30 | 1841 |
| 4 | 20 | 100 | 30 | 1628 |
| 5 | 20 | 120 | 30 | 1716 |

$LSD_{0.05}$ = 245
C V % = 10.95

**Conclusion**

The obtained result depicted that application of fertilizer dose of 20-80-30 NPK kg/ha had significantly improve the pod yield of groundnut.

**3.Evaluating the Impact of Vermicompost and Microbial Inoculation on Growth, Yield and Nutrient Concentration in Groundnut and Soil Fertility**

This study was conducted on groundnut variety BARI-16 to check the integrated effect of vermicompost, microbial inoculation and fertilization on growth and yield of groundnut at experimental field area of Barani Agricultural Research Institute (BARI) Chakwal during 2019. The objective of the study was to check the combined effect of vermicompost and microbial inoculation, to reduce fertilizer application, to improve Soil Fertility and to conserve moisture. The site selected for the experiment was poor in fertility with organic matter 0.7%, Nitrate Nitrogen 3ppm Phosphorus 5ppm, Potassium 180ppm, pH 7.6 and EC 0.78dSm$^{-1}$ and texture of soil was loam with low moisture contents 12% in upper layer (0-6 inch) and 20% in lower layer (6-12 inch) of soil. This study was designed using the layout of RCBD factorial (randomized complete block design) design with three replications. Two levels of vermicompost (0, 2 t ha$^{-1}$), microbial inoculation (BF) and recommended dose (RDF) of NPK (30-

80-30) in kg $ha^{-1}$ was applied on the basis of soil test at the time of sowing. The treatments were designed as follow in Table 72 and Table 73 shows nutrient contents of vermicompost used in experiment.

**TREATMENTS/ METHODOLOGY:**

**Table 72: Treatments of the study**

| | **Treatments** | **Description** |
|---|---|---|
| T1 | Control | No Fertilizer |
| T2 | RDF | Recommended dose of Fertilizers (30-80-30) kg $ha^{-1}$ |
| T3 | VC | Vermicompost @ 2t $ha^{-1}$ |
| T4 | BF | Consortium inoculation |
| T5 | RDF+VC | Recommended dose of Fertilizers + Vermicompost |
| T6 | RDF+BF | Recommended dose of Fertilizers + Consortium inoculation |
| T7 | VC+BF | Vermicompost + Consortium inoculation |
| T8 | RDF+VC+BF | Recommended dose of Fertilizers + Vermicompost + Consortium inoculation |

Sowing date of groundnut was conducted during the first of April. Seed was inoculated with biofertilizer before sowing and recommended dose of fertilizer was also applied at sowing time. Data on pre sowing soil analysis, plant density Plant height (cm), No. of pods/plant, Pod yield (kg/ha), 100 seed weight (g), Haulem weight (kg/ha) was collected (Table 74) and analysed statistically using statistics 8.1.

**Table 73: Nutrient content of vermicompost**

| **Nutrient elements** | **Unit** | **Vermicompost** |
|---|---|---|
| Organic carbon | *%* | > 25 |
| Nitrogen | *%* | 1-2 |
| Phosphorus | *%* | 0.2-0.3 |
| Potassium | *%* | 0.8-2 |
| Magnesium | *mg* $kg^{-1}$ | 300-500 |
| Zinc | *mg* $kg^{-1}$ | > 100 |
| Copper | *mg* $kg^{-1}$ | > 20 |
| Iron | *mg* $kg^{-1}$ | > 1000-1500 |

| | | |
|---|---|---|
| CN ratio | | 13-20 |
| pH | | 6.5-7.5 |
| Moisture | % | 20-30 |

**Table 74: Evaluating the impact of vermicompost and Microbial inoculation on growth, yield and nutrient concentration in groundnut**

| *Treat* | No. of Plants/m$^2$ | | Pod Yld (kg/ha) | | No. of pods/Plant | | 100 kernalwt (g) | | Plant ht (cm) | | Haulem (kg/ha) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Control** | 9.33 | | 273 | | 32 | | 40 | | 23 | | 410 | |
| **RDF** | 10.33 | | 1071 | | 65 | | 53 | | 37 | | 1927 | |
| **VC** | 10 | | 548 | | 50 | | 50 | | 32 | | 987 | |
| **BF** | 10.33 | | 631 | | 58 | | 53 | | 33 | | 1132 | |
| **RDF+VC** | 10.67 | | 1194 | | 69 | | 55 | | 36 | | 2150 | |
| **RDF+BF** | 11.33 | | 1282 | | 77 | | 56 | | 38 | | 2307 | |
| **VC+BF** | 9.33 | | 753 | | 61 | | 51 | | 33 | | 1356 | |
| **RDF+VC+BF** | 12 | | 1630 | | 84 | | 58 | | 42 | | 2933 | |
| | *CV* | *5.08* | *CV* | *10.51* | *CV* | *8.08* | *CV* | *4.55* | *CV* | *10.31* | *CV* | *11* |
| | *SE* | *0.432* | *SE* | *79* | *SE* | *4* | *SE* | *1.89* | *SE* | *2.87* | *SE* | *14* |

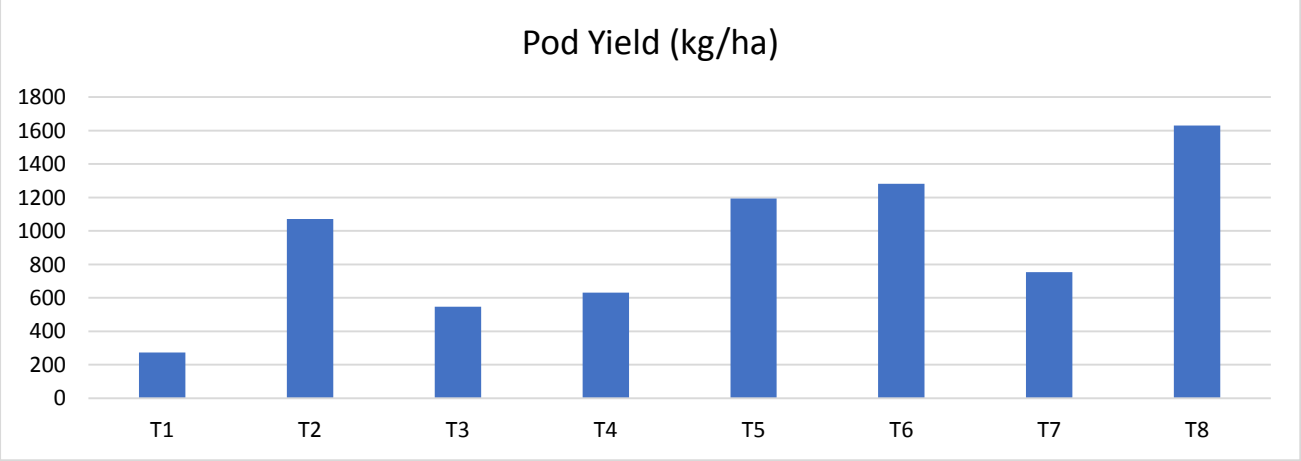



**Figure 9: Pod Yield of groundnut as influenced by Vermicompost and Microbial inoculation**

## Conclusion

This study concluded that the treatment *consortium inoculation(PSB)* + vermicompost @ 2 t/ha along with recommended dose of fertilizers significantly improved crop yield and yield attributes.

**RABI 2019-20**

**4.Fertilizer Requirements of New Promising Lines of Wheat Under Rainfed Conditions**

**Objective**

- The purpose of this study was to find out an optimum fertilizer dose for new promising lines of wheat (16C038) under rainfed conditions
- To increase fertilizer use efficiency and to improve the soil and overall crop productivity

**Summary**

A field experiment was conducted during 2019-20 under rainfed condition at experimental field area of Barani Agricultural Research Institute (BARI) Chakwal. The study was conducted on a sandy loam soil low in organic matter (0.59 %) with extractable K (110 mg/kg), extractable P (4.2 mg $kg^{-1}$) and a soil pH of 8.1.(Table 74&75) This study was designed using the layout of RCBD factorial (randomized complete block design) design with 6 treatments of 1.2m * 5m plot and with three replications. Sources of N, P and K were urea, single super phosphate and murate of potash respectively. The crop was sown on Oct 29, 2019 and harvested on March 14, 2020. The collected data was subjected to statistical analysis using analysis of variance technique (ANOVA) and the mean value was compared by Least Significant Difference (LSD) test at 5% probability level.

The fertilizer treatments were applied at the time of sowing respectively. Data showed that maximum of the crop parameters i.e Spike length (11.33cm), seed of three spikes (56.33), 1000 grain weight (30 g) and total yield(2.51 kg/ha) showed better results in fertilizer level 120-60-30 (kg/ha) presented in figure 2,3,6 and 7 as compared to other treatments. It was followed by fertilizer level 90-30-30 (kg/ha) that showed better result in two others crop parameters i.e Plants /$m^2$ i.e 421.5 /$m^2$

(figure 10) and in biomass weight i.e 9.1g showed in figure 5. The lowest results were in control where none of the fertilizer treatments was applied. All other treatments were statistically superior to the control treatment (shown in figures 11,12, 13,14,15).

**Previous Year Result`**

**Table 75: Pre-sowing Soil Analysis:**

| Depth (cm) | pH | EC (dS/m) | OM (%) | N (%) | Av. P (mg/kg) | Moisture (%) | Texture |
|---|---|---|---|---|---|---|---|
| 0-15 | 8.2 | 0.66 | 0.60 | 0.030 | 6.8 | 6.36 | S C loam |
| 15-30 | 8.0 | 0.64 | 0.64 | 0.032 | 5.1 | 7.20 | -do- |

**Table 76: Post sowing soil analysis**

| Depth (cm) | pH | EC (dS/m) | OM (%) | N (%) | Av. P (mg/kg) | Moisture (%) | Texture |
|---|---|---|---|---|---|---|---|
| 0-15 | 8.2 | 0.63 | 9.61 | 0.031 | 7.0 | 5.5 | SC loam |
| 15-30 | 8.0 | 0.59 | 0.65 | 0.033 | 5.8 | 6.55 | D0 |

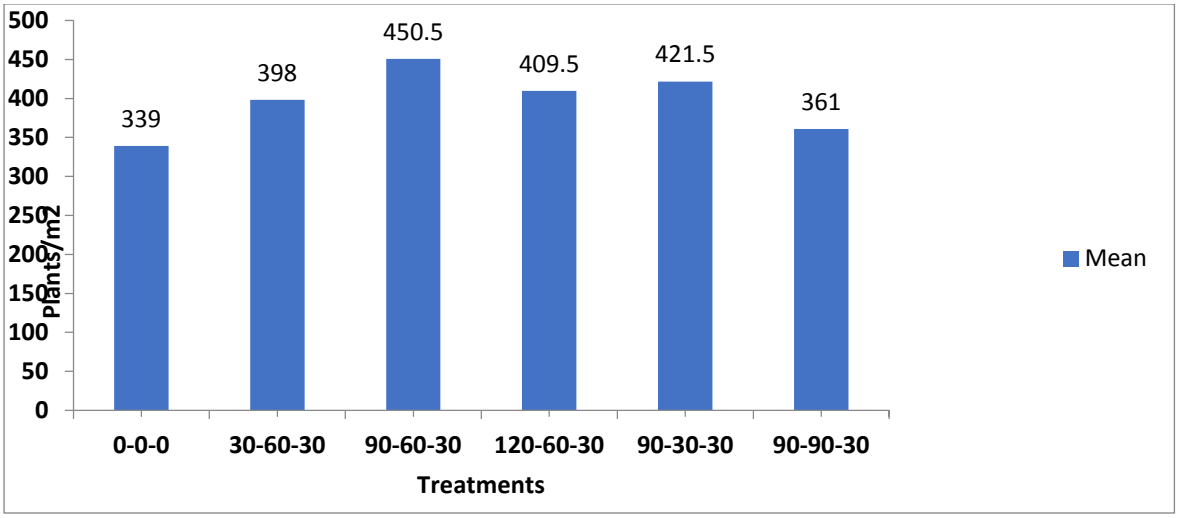


**Figure10: Response of Different fertilizer Treatments on no of Plants/ $m^2$ of wheat**

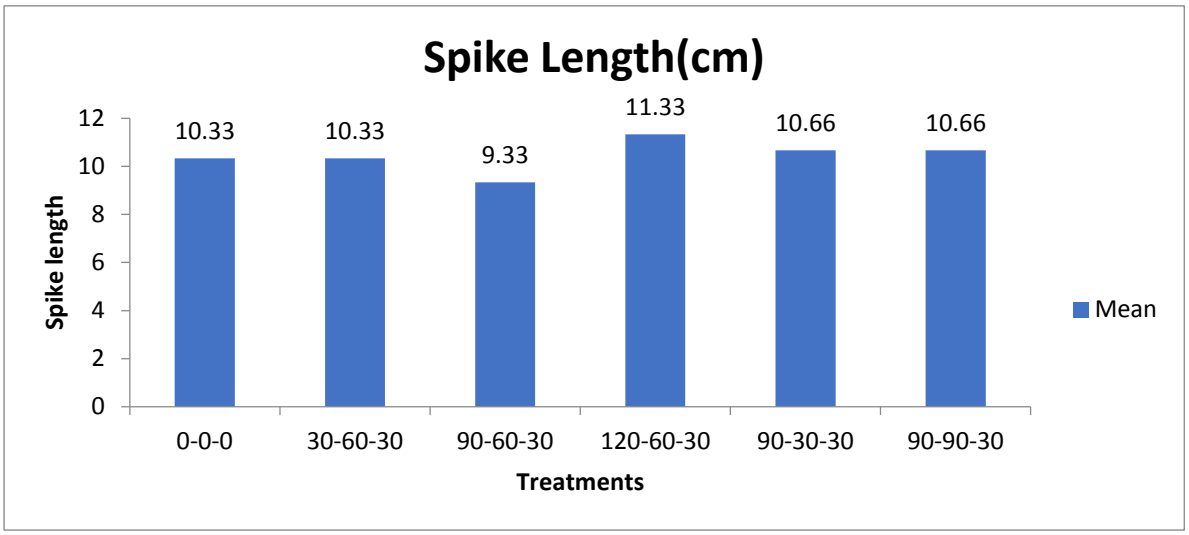



**Figure11: Response of Different fertilizer Treatments on spike length of wheat**

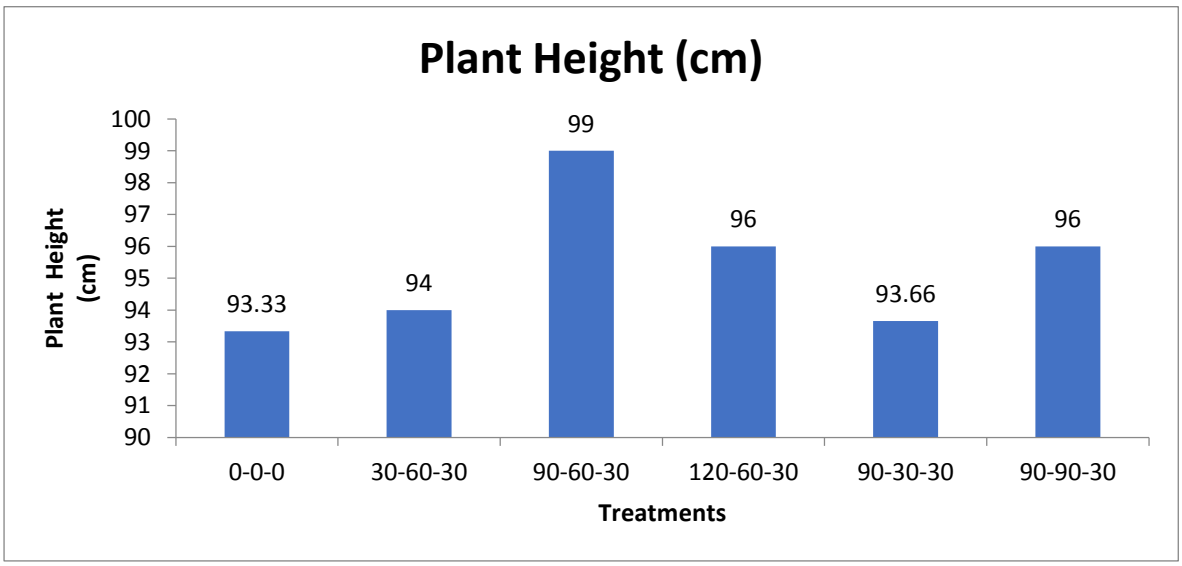



**Figure12: Response of Different fertilizer Treatments on plant height of wheat**

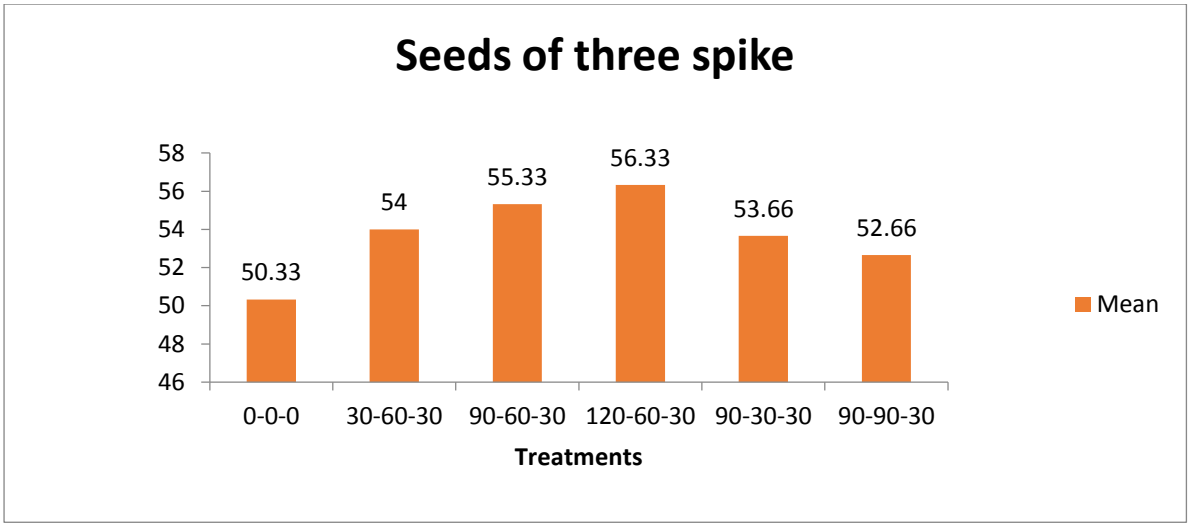



**Figure 13: Response of Different fertilizer Treatments on seed of three spike of wheat**

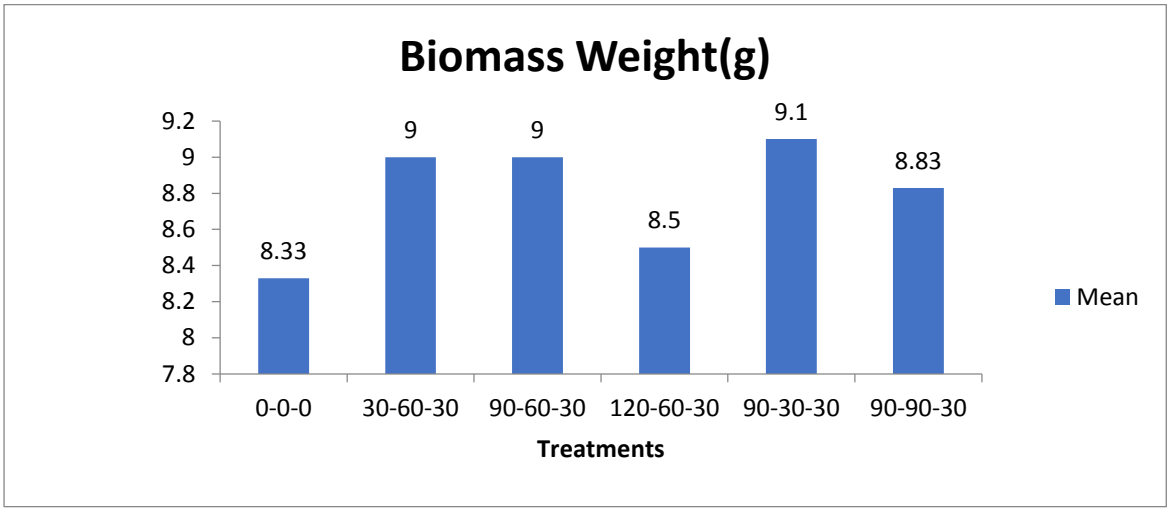



**Figure 14: Response of Different fertilizer Treatments on biomass weight of wheat**

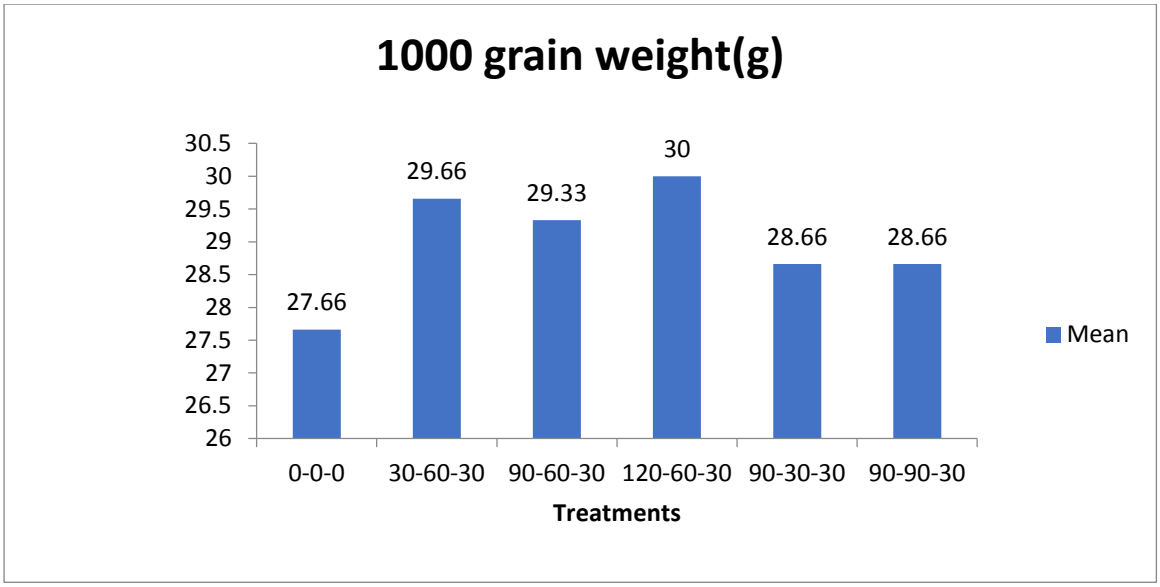



**Figure 15: Response of Different fertilizer Treatments on 1000 grain weight of wheat**

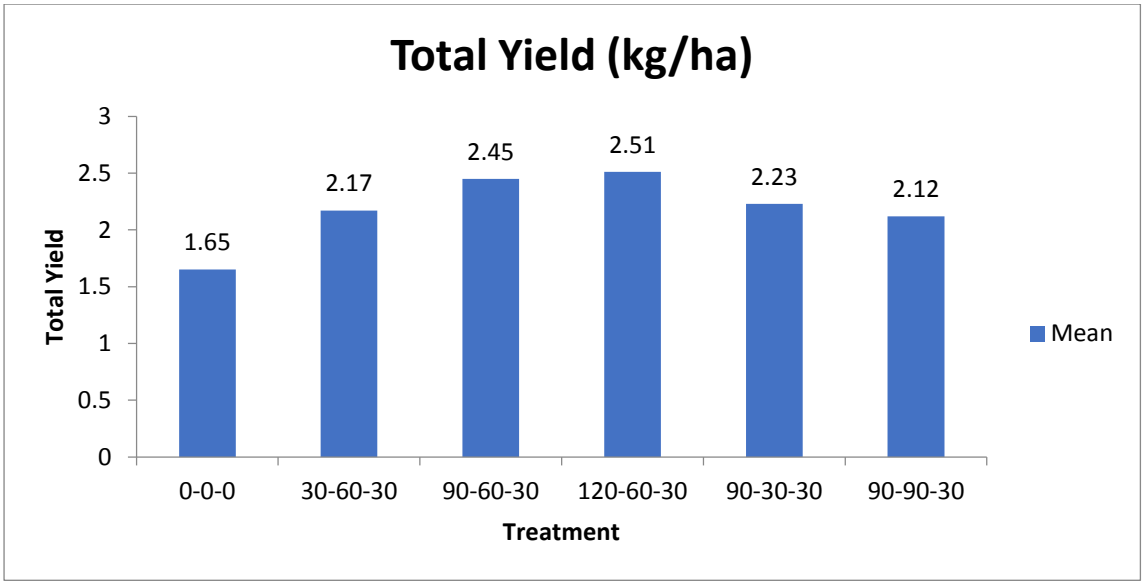



**Figure 16: Response of Different fertilizer Treatments on total yield of wheat**

## Conclusion

It is concluded from the above experiment that application of fertilizer level 120-60-30 (kg/ha) and 90-30-30 (kg/ha) showed better performance on overall crop productivity and soil nutrients' status as compare to other fertilizer levels.

## PLANT PATHOLOGY

- Screening of disease resistant crop varieties of cereals, food legumes, oilseeds, fodders and Fruits cultivated under rainfed conditions

- Standardization of appropriate plant protection technology for field and fruit crops.
- Laboratory analysis of diseased plant samples received from farming community and advice for the management of problem.
- Transfer of modern plant protection technologies to farmers of rainfed region through modern mass communication techniques.
-

**1.Screening of wheat advance lines for resistance to leaf and stripe Rust.**

Rust in wheat is a serious threat worldwide and causes a significant loss in yield that may be more than 90% in case of susceptible variety or under epidemic conditions. Among different rusts of wheat, Stripe rust (Puccinia striiformis f. sp. tritici) and leaf rust (Puccinia recondita f. sp. tritici) pose a serious threat to wheat production in northern Punjab and KPK. Utilization of rust-resistant genotypes is the most economical and environmentally sound approach to reduce rust damage, as it protects grain yield and reduces the need for fungicides. Screening wheat advanced material against rusts is a routine practice in the institutes wherever wheat breeding programme is conducted. Trial was conducted with an objective to screen the advanced material against leaf rust and stripe rust under local situation. Data generated is helpful to categorize material on basis response against two rusts and used in selection of wheat advance lines resistant against leaf and stripe rust for variety development and used in hybridization programme.

For this purpose, thirty-three advanced lines and four cultivars were screened, and severity of rust was recorded following Modified Cobbs Scale. One row Morocco of which is universally susceptible to wheat rusts was planted around the nursery. Data were recorded in the first week of March when the susceptible wheat variety Morocco had been affected considerably and first week of April when the disease in Morocco developed up to 80% severity.

Stripe rust appears earlier than leaf rust. Environment was favourable for stripe rust and did not permit leaf rust to infect. Consequently, a reliable data of wheat advanced material was created for response against stripe rust. However, identification of leaf rust resistant material was not accomplished due to severe attack of stripe rust in this zone. According to results, 1 line was found immune against all the races of yellow rust prevailing in nature. 8 lines showed the

symptoms of resistant as chlorosis was observed without uredia. Similarly, 1 line was moderately resistant and 5 lines were in the range of resistant to moderately resistant. 7 lines were found moderately susceptible while 5 lines/varieties were found moderately susceptible to susceptible. Three cultivars (Chakwal-50, Dharabi-11, Ihsan-16) have lost resistance against stripe rust. Barani17 and 16C038 effectively resisted the disease despite the reality that most of the cultivars showed susceptibility against disease. Our results indicated that a large number of advanced materials in pipeline has high level of resistance and can be used as parents against wheat stripe rust.

**Table 76: Response of 37 lines/varieties against stripe rust infection in wheat**

| **Quality** | **Name of variety/line** |
|---|---|
| Immune | 19C161 |
| Resistant | 19C152, 19C157,19C160, 19C162, 19C166, 18C117, 18C126, 16C038 |
| Resistant to Moderately Resistant | 19C154, 19C158, 19C164, 19C168, Barani-17 |
| Moderately Resistant | 18C124 |
| Moderately Resistant to Moderately Susceptible | 19C153, 19C155, 19C159, 19C163, 18C119, 17C090, 18C121 |
| Moderately Susceptible | 18C118,18C120,18C122, 18C123, 18C125, 18C127,18C128 |
| Moderately Susceptible to Susceptible | 19C156, 19C165, 19C167, 18C116, 17C089, |
| Susceptible | Chakwal-50, Dharabi-11, Ihsan-16 |

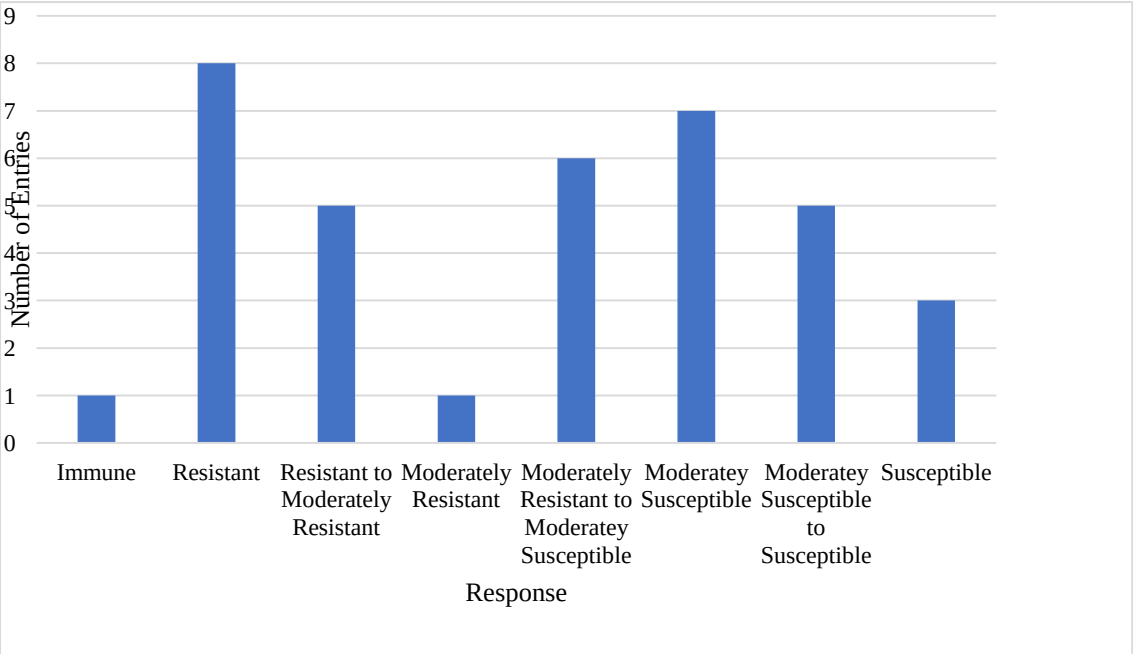



**Figure 17: Categorization of wheat advanced lines on basis of their response to Stripe rust**

**2.Screening of Chickpea advance lines against dry root rot (*Macrophomina phaseolina*) under sick field conditions.**

Chickpea productivity often remains low due to susceptibility of the crop to different biotic and abiotic stresses. Among the diseases dry root rot caused by Rhizoctonia bataticola (Taub.) Butler (pycnidial stage: Macrophomina phaseolina Tassi Goid) is emerging as serious threat to the chickpea growing regions of country. Management can be made feasible and cost effective by identification of new resistant sources which is the only alternative method so as to combat this serious disease, even though chemical control plays an important role in modern agriculture for disease management. Keeping this in view, present investigations were envisaged with the following objective to screen the advanced chickpea lines for resistance to dry root rot in the sick soil.

Thirty-six lines/cultivars of chickpea obtained from Pulses Section, Barani Agricultural Research Institute, Chakwal were screened for the sources of resistance against dry root rot chickpea. Each of the test line was sown in 2 m spacing with 0.3m distance in sick field laid out in Randomized Complete Block Design. General agronomic practices were followed. Equal number of seeds of each entry were sown in each plot. The data on the number of dry root roted plants in each test line were

recorded at 20 days interval. Observations on per cent mortality were finally computed as follows (Table 77).

**Mortality Percentage = (No. of Plants died/Total number of seeds sown) *100**

**Table 77: Resistance of Different Chickpea Lines against dry root rot**

| Sr. No. | Response | Mortality | Name of Entries |
|---|---|---|---|
| 1 | Resistant | 0-10 | 17KCC105, 16KCC107 |
| 2 | Moderately Resistant | 11-20 | 16KCC101, 16KCC106, 17KCC114,18KCC101, 18KCC108 |
| 3 | Moderately Susceptible | 21-30 | 14FCK02, 15FCK16, 15KCC106, 15KCC112,16KCC103, 16KCC104, 16KCC105, 16KCC108, 16KCC109, 17KCC102, 17KCC104, 17KCC106,17KCC107, 17KCC112, 17KCC113,17KCC118, 17KCC120, 18KCC102,18KCC103, 18KCC104, 18KCC105,18KCC106, 18KCC107, 18KCC109,18KCC110, TAMMAN, NOOR |
| 4 | Susceptible | 31-50 | 16KCC110, 17KCC109 |
| 5 | Highly Susceptible | 51-100 | |

**3.Screening of Lentil advance lines against dry root rot (*Macrophomina phaseolina*) under sick field conditions**.

Soil-borne plant pathogens causing root rot disease are among the limiting factors in plant production all over the world. Dry root rot (Rhizoctonia bataticola) is the soil borne disease affecting lentil production and productivity. This pathogen causes economic yield losses in Lentil (Lens culinaris) Disease management is required to ensure the stable lentil production. Application of fungicide is one of the solutions to overcome this problem but field applications is not feasible due to the expense required and technical difficulty in infusing chemicals into the soil. The most sustainable and effective solution to this problem is the development of resistant cultivars. The released varieties exhibit variation for resistance. Stable sources are required for breeding dry rot resistant varieties. Hence this study was carried out with specific objective of identifying lentil genotypes resistant to dry root rot (*Macrophomina phaseolina*) under sick field conditions. The experimental material for the present study comprised of 41 lentil genotypes. The field experiment was laid out in Randomized Complete Block Design (RCBD) with three replications per entry

(3 rows per replication) with plot size of 2 m x 0.3m. Observations on disease incidence were recorded at twenty days interval just after appearance of the disease. In this study lentil genotypes were screened for resistance (Table 78) to dry root rot under sick field conditions. Several accessions with moderate level of resistance under sick field conditions were identified.

**Table 78: Categorization of Lentil advanced lines on basis of their response to dry root rot**

| Sr. No. | Response | Mortality | Name of Entries |
|---|---|---|---|
| 1 | Resistant | 0-10 | 17KCC105, 16KCC107 |
| 2 | Moderately Resistant | 11-20 | 15CL303, 15CL305, 15CL306, 15CL307, 16CL302, 17CL304,18CL305,18CL309, CH-MASOOR |
| 3 | Moderately Susceptible | 21-30 | 18CL301,18CL302,18CL303,18CL304, 17CL301,17CL302,17CL303, 17CL305, 17CL307, 17CL308, 17CL309, 16CL301, 16CL303, 16CL304, 16CL305, 16CL306, 16CL308, 15CL301, 15CL302, 15CL308, 15CL309, MARKAZ09, |
| 4 | Susceptible | 31-50 | 18CL306, 18CL307, 18CL308, 17CL306, 16CL307, 15CL304, 14CL305, PAK-MASOOR |
| 5 | Highly Susceptible | 51-100 | 14CL304,15CL310, |

**4.Wheat screening for sources of durable resistance in wheat against stripe rust**

Wheat (*Triticum aestivum* L.) stripe (syn. yellow) rust caused by *Puccinia striiformis* f. sp. *tritici* (Pst), is one of the most devastating wheat diseases in the world. Stripe rust can cause yield losses from 10 to 100%. Among all the control measures of this disease, genetic resistance is the only economic and practical control measure, causing no additional cost to the farmer. However, only race-specific, major genes based resistant have been deployed in past. Furthermore, most of the released varieties were based on only a few major genes. This results in a kind of mono-culturing regarding resistance genes. Inqilab in Pakistan and PBW343, in India; both were based on Yr27 which has been broken down causing severe losses. Such major gene(s)-based resistance is lost very rapidly due to evolution of virulence by the pathogen to these genes. The phenomenon of the erosion of such genes, or their combinations, led scientists to look for alternative approaches to resistance management. Enduring resistance is very noteworthy and successful way to combat

rust dilemma in wheat crop. The concept of durable resistance is defined as 'resistance that remains effective when deployed over extensive acreage and time, in an environment favorable for the disease'. Therefore, durable resistance remains effective after widespread deployment over a considerable period of time. This type of resistance is mainly associated with minor genes, also known as slow rusting genes, and is generally controlled by more than one gene during the adult-plant stage rather than the seedling-resistant stage, and shows non-HRs to infection. In wheat cultivars, the presence of a single resistance gene is generally less effective for controlling rust disease, whereas the combination of two or more genes enhances resistance durability. This approach was widely used for commonly known as slow rusting, has dominated in CIMMYT's bread wheat improvement. Numerous terms have been used in the literature to describe various features of resistance.

Fifteen advanced lines which showed susceptible response were selected to identify slow ruster genotypes. Area Under Disease Progress Curve was used as parameter to identify slow rusters. Disease data was recorded following modified Cobbs scale with fortnightly interval and converted into Coefficient of infection to calculate Area Under Disease Progress Curve. Yield data was recorded also and presented in the Figure 18.

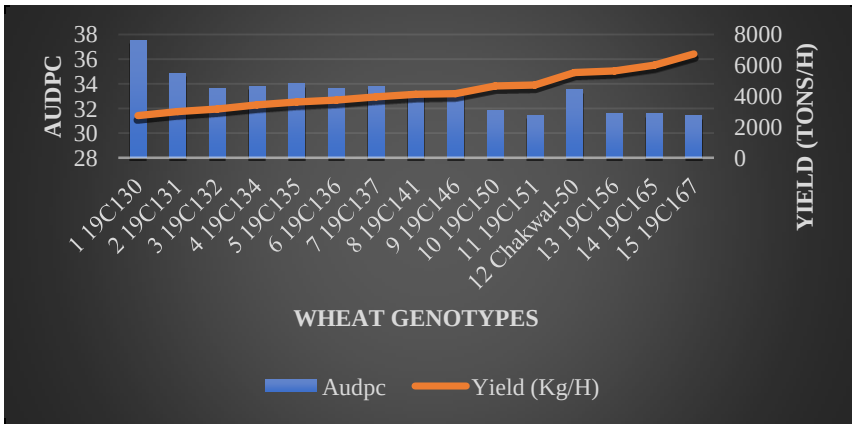



**Figure18: Area Under Disease Progress Curve and Yield in Wheat Genotypes**

### 5.Effect of foliar application of systemic fungicide against stripe rust in wheat at various growth stages

Unlike other crop diseases, Stripe Rust deserves special attention when deciding on fungicide application timing. Being the most destructive disease of wheat, producers and government institutions should ensure that the use of fungicides minimizes losses, especially in susceptible varieties. It should also be remembered that in the

current social and environmental context, the use of fungicides requires an in-depth analysis that ensures sustainability to avoid environmental damage and unnecessary applications while ensuring the sought profitability. For these reasons, the analysis, interpretation and the definition of the optimal fungicide timing for Stripe Rust control is a relevant aspect. Frequent recommendation is based on the wheat growth stage as an indicator of fungicide timing. There is a general acceptance among producers and consultants that the main objective of a fungicide is to “protect and cure the host” without taking into account its action on pathogens. In this way, fungicides are applied depending on the crop phenological stage with the mission that the upper leaves, mainly involved in the generation of grain yield, receive the chemical. Current study has been conducted to determine the most appropriate growth stage in wheat crop for spray of fungicide to mitigate the effect of stripe rust on yield. Susceptible variety (Ihsan 2016) was selected based on its performance during the year 2019/2020. Net plot size was kept as 3 m x 1.8m (5.4m$^2$) with 3 replications under RCBD, layout. Various growth stages were obtained by sowing at various dates. Difenoconazole was sprayed at initiation of disease. Data of various Yield parameters like Biological Yield, No. of grains/ spike, Grain weight/20 spike, 1000 grain weight and Yield kg /Ha was recorded at harvesting and presented in the Table below. Results indicated sprayed at milky stage and in pre-booting stage affected yield and yield parameters significantly. Impact of application of difenoconazole against Stripe rust on various wheat parameters in wheat is presented as under in figure 19,20,21,22,23 &24

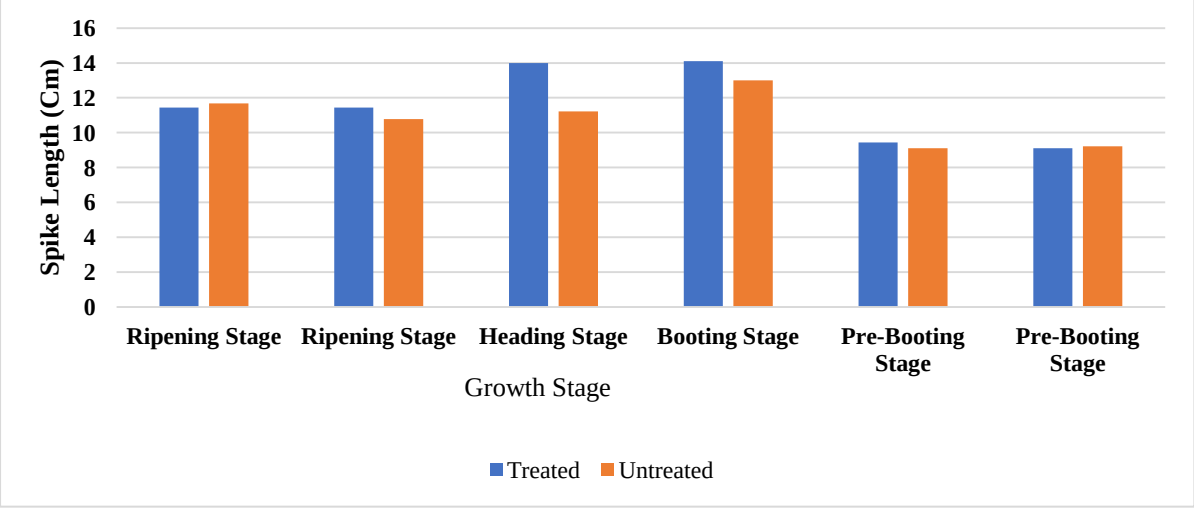


**Figure 19: Impact of application of difenoconazole against Stripe rust on Spike Length at various growth stages**

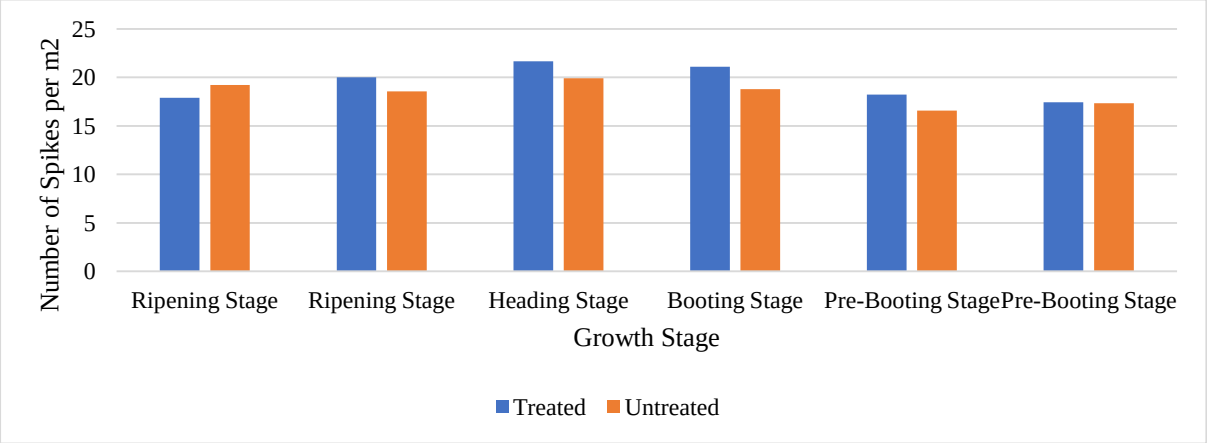



**Figure 20: Impact of application of difenoconazole against Stripe rust on number of spikes/m$^2$ at various growth stages**

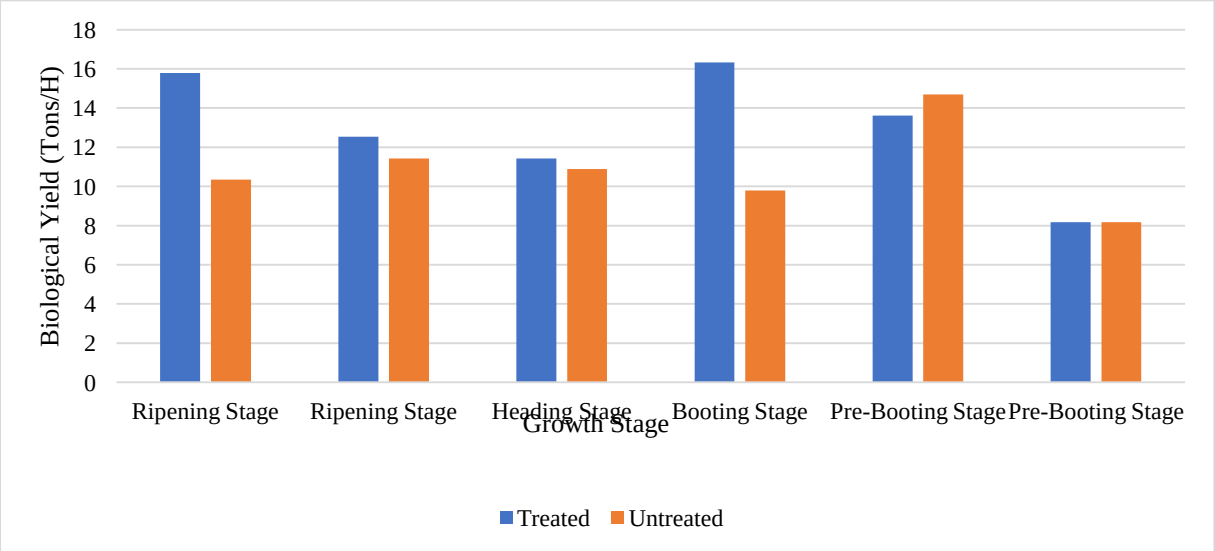



**Figure 21: Impact of application of difenoconazole against Stripe rust on number of biological yield (Tons/H) at various growth stages**

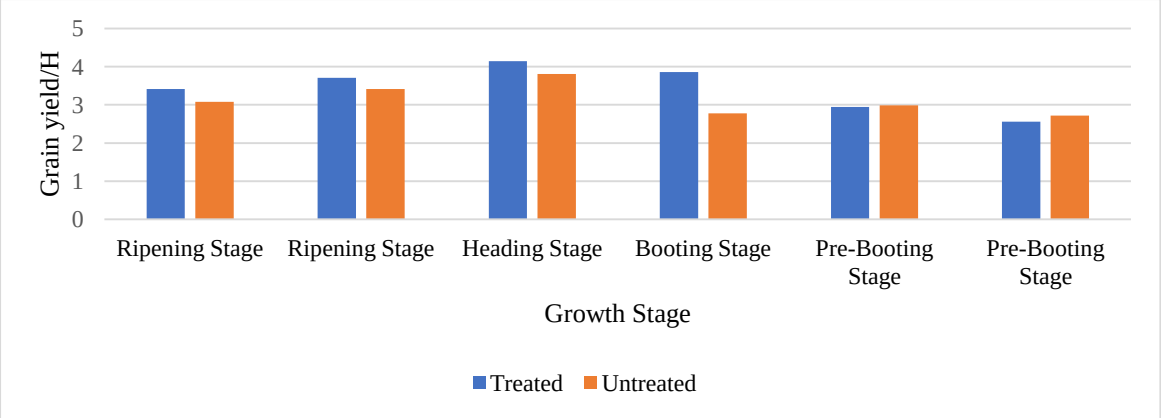



**Figure 22: Impact of application of difenoconazole against Stripe rust on yield (Tons/H) at various growth stages**

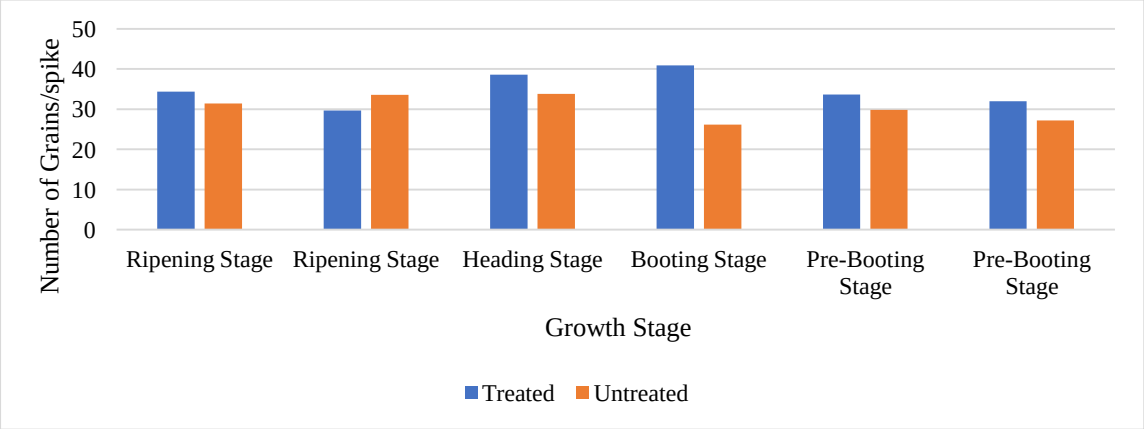



**Figure 23: Impact of application of difenoconazole against Stripe rust on number of grains per spike at various growth stages**

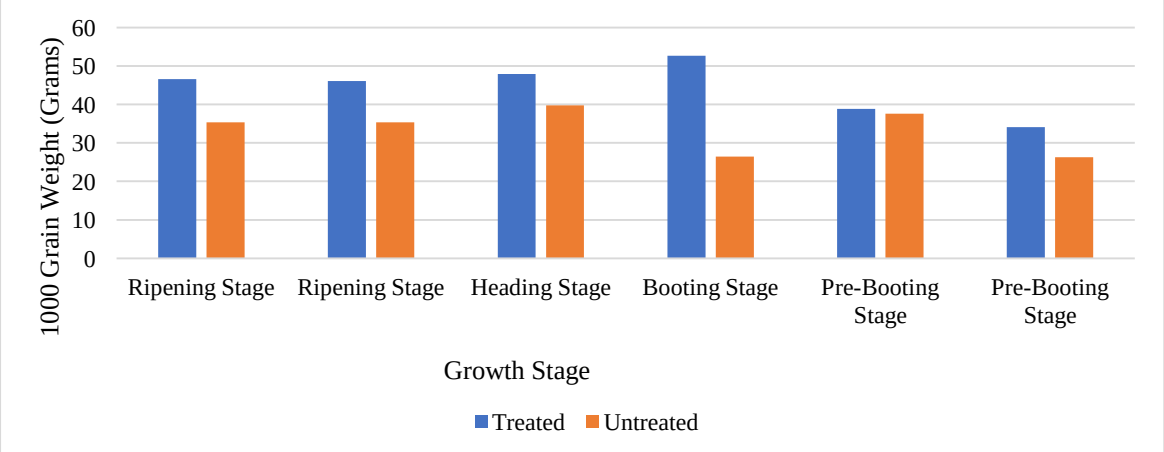



**Figure 24: Impact of application of difenoconazole against Stripe rust on 1000 grain weight at various growth stages**

**Surveillance of Wheat Rust:**

Wheat crop was surveyed for rust incidence in six districts (Gujrat, Jhelum, Chakwal, Mianwali, Rawalpindi and Attock) and disease samples were collected and sent to CDRP for further analysis. A training of Officers in Agriculture Department (Extension Wing) was conducted in collaboration with Wheat Productivity Enhancement Programme in connection with Rust management. Beside a survey was conducted in five districts and weekly disease progress report was sent to higher authority.

A training of Officers in Agriculture Department (Extension Wing) was conducted in collaboration with Wheat Productivity Enhancement Programme in connection with Rust management.

## AGRICULTURAL ENGINEERING

**Objectives:**

- To enhance crop production and conserve water through water and energy saving techniques**.**

### 1.Effect of Hydrogel Granules on The Wheat Productivity by Maintaining Soil Moisture at Root Zone Depth.

Wheat (Ahsan-2017) was sown in field on October 22, 2019 in randomized complete block design with the following treatments, Three treatments T1 = hydrogel application @ 35 kg/ha, T2 = hydrogel application @ 65 kg/ha, T3 = Control with three replications. Ahsan 17 variety was selected for the treatment. The size of plots was 4 m x 1.8 m (7.2 $m^2$) and the net sown area was 22 $m^2$ (0.0022 ha).

Fertilizer was applied to the field with the ratio of 50-75-50 NPK kg/ha. During the experiment moisture content were monitored gravimetrically. Dose rate of hydrogel was taken 35 kg/ha and 65 kg/ha. In T1and T2 hydrogel was applied alongwith fertilizer. Hydrogel is a water absorbent polymer and it can retain moisture in it for longer periods of time.

The germination start was observed after sowing in plots with application of hydrogel and control plots. The germination count was done after 25 days of sowing (DAS) from one-meter row length of sowing. For this, in every replication of the treatment at three places, 1-meter length of crop was randomly selected and germination count was made. Average germination was calculated.

For determination of plant height, ten plants were selected randomly from each marked space and height of plants was measured at 30 and 120 DAS by using standard procedure. Then average heights of plants were calculated. Harvesting was done on May 02, 2020 and spike height (cm), no.of grains/spike, 1000 grain weight (g) ad total yield (kg/ha) was calculated.

Crop data of wheat is given in table 79.

**Table 79: Crop data of different treatments**

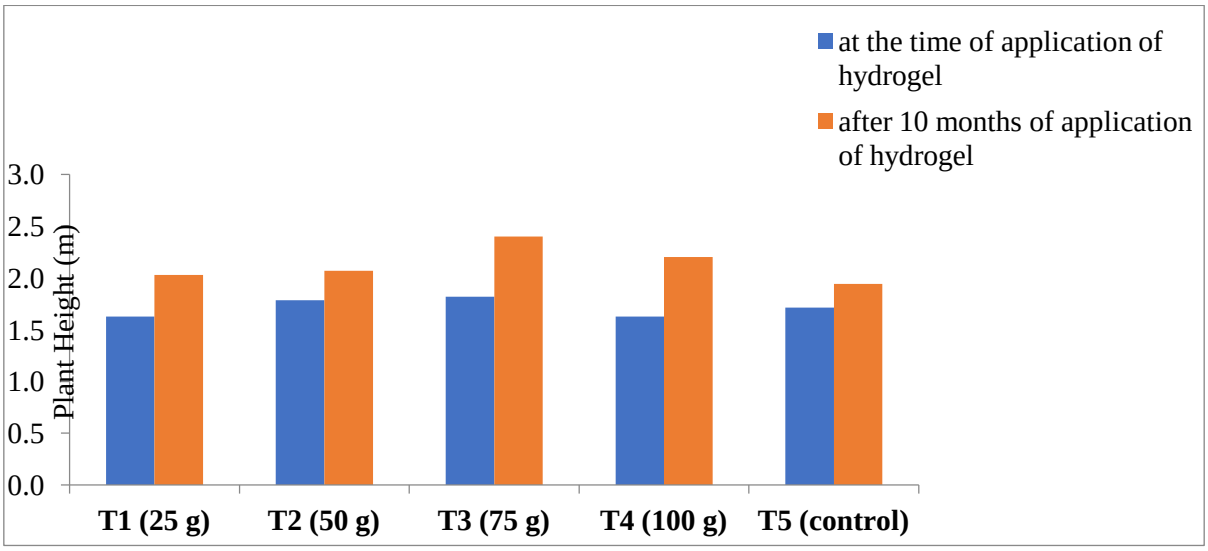
| | | Germination count | Plant height (cm | | Spike length (cm) | No. of grains/ spike | 1000 grain weight (g) | Total Yield kg/ha |
|---|---|---|---|---|---|---|---|---|
| **Treatments** | **Reps** | | **30 DAS** | **120 DAS** | | | | |
| T1 | R1 | 99 | 32 | 107 | 15 | 43 | 42.75 | 5500 |
| | R2 | 100 | 30 | 103 | 15 | 43 | 41.75 | 5393 |
| | R3 | 100 | 30 | 111 | 14 | 41 | 42.5 | 5305 |
| | Avg | 100 | 31 | 107 | 15 | 42 | 42 | 5399 |
| | SD | 0.509 | 0.846 | 4.131 | 0.721 | 0.918 | 0.520 | 97.671 |
| | CV | 0.51 | 2.76 | 3.87 | 4.94 | 2.18 | 1.23 | 1.81 |
| T2 | R1 | 105 | 34 | 100 | 12 | 38 | 39.75 | 5200 |
| | R2 | 106 | 35 | 99 | 12 | 39 | 40.75 | 5138 |
| | R3 | 104 | 35 | 104 | 12 | 40 | 40.75 | 5150 |
| | Avg | 105 | 35 | 101 | 12 | 39 | 40 | 5163 |
| | SD | 0.88 | 0.31 | 2.68 | 0.20 | 1.00 | 0.58 | 33.07 |
| | CV | 0.84 | 0.88 | 2.66 | 1.69 | 2.57 | 1.43 | 0.64 |
| T3 | R1 | 93 | 25 | 93 | 10 | 38 | 33.5 | 4275 |
| | R2 | 90 | 26 | 94 | 9 | 37 | 37 | 4137.5 |
| | R3 | 93 | 23 | 92 | 11 | 39 | 36 | 4242.5 |
| | Avg | 92 | 24 | 93 | 10 | 38 | 36 | 4218 |
| | SD | 1.925 | 1.206 | 1.190 | 0.611 | 0.918 | 1.803 | 71.865 |
| | CV | 2.094 | 4.927 | 1.281 | 6.151 | 2.444 | 5.078 | 1.704 |

**Water Retention data**

The variation in soil moisture level for each plot after application of hydrogel was carried out after 21 and 31 days after sowing, respectively. The soil moisture level varied with the dose rate of hydrogel used in each plot. Effective rainfall received during the growing season was 277 mm, and hydrogel applied plots showed water retention as compared to control.

**2. Effect of Hydrogel on Soil Moisture and Growth of Olive Plants.**

05 treatments T1= 25g hydrogel, T2 = 50g hydrogel, T3 = 75 g hydrogel, T4 = 100 g hydrogel and T5 = control. The highest amount of water was saved in 100 g T4 treatment but the growth parameters were giving highest results for T3= 75 g hydrogel treatment. Results are showed in Figure 25 & 26.



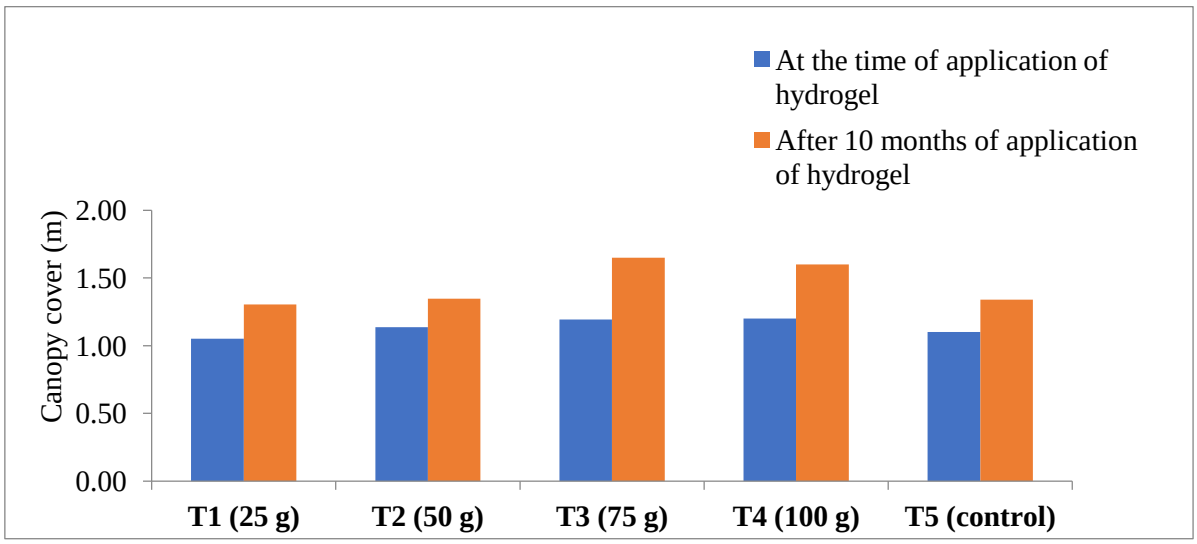




**Figure 25 & 26: Crop data of hydrogel application on olive plants and its comparison with control.**

**3. Impact of hydrogel granules on the production of groundnut by maintaining the soil moisture at root zone depth.**

Groundnut (BARI-2011) was sown in field on April 8, 2019 in randomized complete block design with the following treatments, T0= control, T2= application of hydrogel

by side dressing and T3= Hydrogel application through broadcast. The size of plots was 4 m x 1.8 m (7.2 $m^2$) and the net sown area was 22 $m^2$ (0.0022 ha) as shown in Figure 27.

Fertilizer was applied to the field with the ratio of 25-80-25 NPK kg/ha. Row to row and plant to plant distance was 0.45m ×0.2m respectively. During the experiment moisture content were monitored gravimetrically and through digital tools. Dose rate of hydrogel was taken 35 kg/ha. In treatment T2 hydrogel was applied through side dressing (hydrogel first and seed on it) and in T3 it was applied through broadcast along with fertilizer. Hydrogel is a water absorbent polymer and it can retain moisture in it for longer periods of time.

The germination start was observed after sowing in plots with application of hydrogel and control plots. The germination count was done after 25 days of sowing (DAS) from one-meter row length of sowing. For this, in every replication of the treatment at three places, 1-meter length of crop was randomly selected and germination count was made. Average germination was calculated.

For determination of plant height, ten plants were selected randomly from each marked space and height of plants was measured at 30 and 120 DAS by using standard procedure. Then average heights of plants were calculated.

20 pod length was calculated by taking randomly 20 pods from each replication of each treatment, took its length by foot scale and then took their average. 100 pod weight (g) and 100 grain weight (g) were taken to calculate shelling percentage (%) by dividing 100 grain weight to 100 pod weight and multiply with 100.


**Figure 27: Hydrogel application through (a) Side dressing and (b) through broadcast Determination of pod and grain yield:**

A crop cutting experiment was conducted. The crop within 1×1 m size M.S. bar frame was harvested at the ground level by sickle. The crop was weighed and threshed manually. The weight of clean pod and grain collected were measured. The average pod and grain yield for three plots were calculated using the following relationships:

Average crop pod yield, kg/ha = (Average weight of pods collected from one square meter area, kg) × $10^4$

Average grain yield, kg/ha = (Average weight of grains collected from one square meter area, kg) × $10^4$

Crop data of groundnut is given in table 2.

**Table 80: Crop data of different treatments**

| Treatments | Reps | Germination count | Plant height (cm | | 20 Pod length (cm) | Shelling percentage (%) | Pod yield (kg/acre) | Grain yield (kg/acre |
|---|---|---|---|---|---|---|---|---|
| | | | 25 DAS | 180 DAS (at harvest | | | | |
| T0 | R1 | 24 | 9 | 20 | 4.0 | 78 | 809 | 464 |
| | R2 | 25 | 9 | 22 | 3.6 | 77 | 863 | 495 |
| | R3 | 23 | 8 | 21 | 3.5 | 77 | 778 | 492 |
| | Avg | 24 | 8 | 21 | 4 | 77 | 817 | 484 |
| | SD | 0.84 | 0.38 | 0.62 | 0.26 | 0.30 | 42.94 | 17.21 |
| | CV | 3.48 | 4.54 | 2.93 | 7.00 | 0.39 | 5.26 | 3.56 |
| T2 | R1 | 26 | 9 | 24 | 3.3 | 80 | 908 | 555 |
| | R2 | 26 | 7 | 25 | 3.2 | 78 | 920 | 538 |
| | R3 | 26 | 8 | 25 | 3.4 | 83 | 843 | 538 |
| | Avg | 26 | 8 | 25 | 3 | 80 | 890 | 543 |
| | SD | 0.38 | 0.80 | 0.42 | 0.07 | 2.53 | 41.23 | 9.80 |
| | CV | 1.49 | 10.15 | 1.68 | 2.15 | 3.14 | 4.63 | 1.80 |
| T3 | R1 | 28 | 8 | 30.70 | 3.4 | 76 | 1019 | 538 |
| | R2 | 27 | 8 | 33 | 3.2 | 79 | 962 | 574 |
| | R3 | 28 | 9 | 35 | 3.2 | 78 | 956 | 557 |
| | Avg | 28 | 8 | 33 | 3 | 78 | 979 | 556 |
| | SD | 0.33 | 0.52 | 2.01 | 0.11 | 1.35 | 34.42 | 18.41 |
| | CV | 1.20 | 6.18 | 6.14 | 3.40 | 1.74 | 3.52 | 3.31 |

**Water Retention data**

The variation in soil moisture level for each plot after application of hydrogel was carried out after 21 and 31 days after sowing, respectively. The soil moisture level

varied with the application method of hydrogel used in each plot. Effective rainfall received during the growing season was 277 mm, and hydrogel applied plots showed water retention as compared to control (Figure 28).

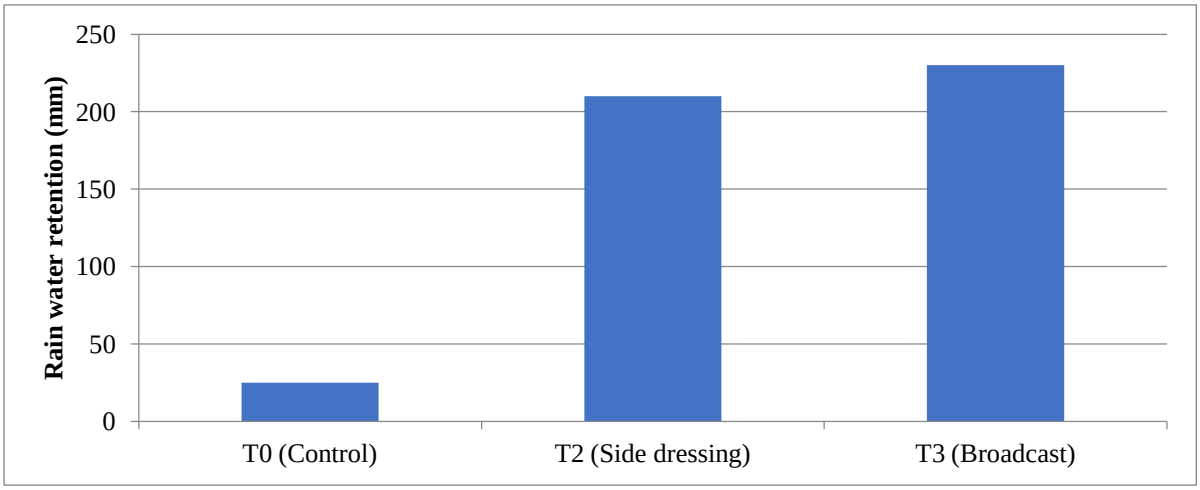



**Figure 28: Amount of rainwater retention in different treatments**

**4.Application of Hydrogel Through Bare Root Dipping Method on Chilies Plants to Check Effect on Soil Moisture and Growth of Plants.**

Chillies (VS-5) was transplanted in field on April 05, 2019 in randomized complete block design with the following treatments, T1= Seedlings treated with hydrogel and T2= Control. The size of plots was 2 m x 3 m (6 $m^2$) and the net sown area was 54 $m^2$ (0.0054 ha). Fertilizer (DAP, SOP) was applied to the field with the ratio of 50: 50 kg /acre respectively. Transplanting was done on 05 April 2019. After transplantation in the field 75 kg/acre urea was applied to the field. In T1 Chilies seedlings were dipped in hydrogel solution (hydrogel dose @ 5 kg/acre) and then transplanted in the field. During the experiment moisture content were monitored gravimetrically. Crop data of the chilies is given in Table 81. Plant height data of the chilies were taken after 30, 50, 70 and 100 days after planting and shown in Figure 29.

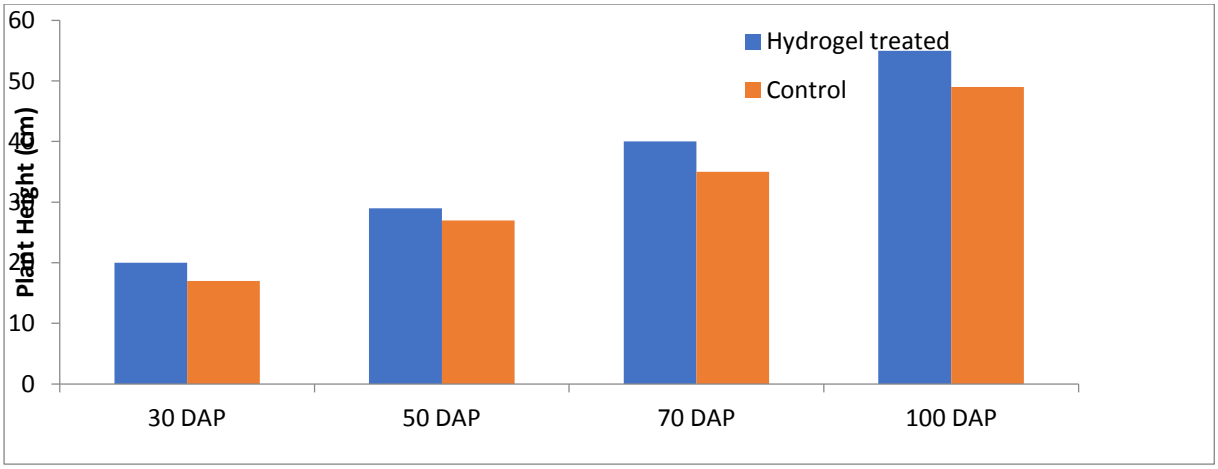



**Figure 29: Plant height data of chilies**

**Table 81: Crop data of the chilies**

| **Treatments** | **Replications** | **Fuits/plant (4 pickinhs)** | **Weight of chilies/plant (4 pickings)** | **Yield/ha** |
|---|---|---|---|---|
| | | | (g) | kg |
| T1 | R1 | 135 | 405.00 | 10000 |
| | R2 | 145 | 430.00 | 10200 |
| | R3 | 150 | 450.00 | 9000 |
| | R4 | 160 | 465.00 | 9600 |
| | **Mean** | 148 | 438 | 9700 |
| | **SD** | 10.41 | 25.98 | 529.15 |
| | **CV** | 7.06 | 5.94 | 5.46 |
| T2 | R1 | 130 | 370.00 | 8600 |
| | R2 | 150 | 346.00 | 9000 |
| | R3 | 123 | 320.00 | 7200 |
| | R4 | 105 | 350.00 | 9600 |
| | **Mean** | 127 | 347 | 8600 |
| | **SD** | 18.60 | 20.55 | 1019.80 |
| | **CV** | 14.65 | 5.93 | 11.86 |

**Irrigation Data:**

Figure 8 showed the irrigation data in chilies. 350 mm effective rainfall received during the growing season of chilies. Less irrigation was applied in the hydrogel treated treatment as compared to control.

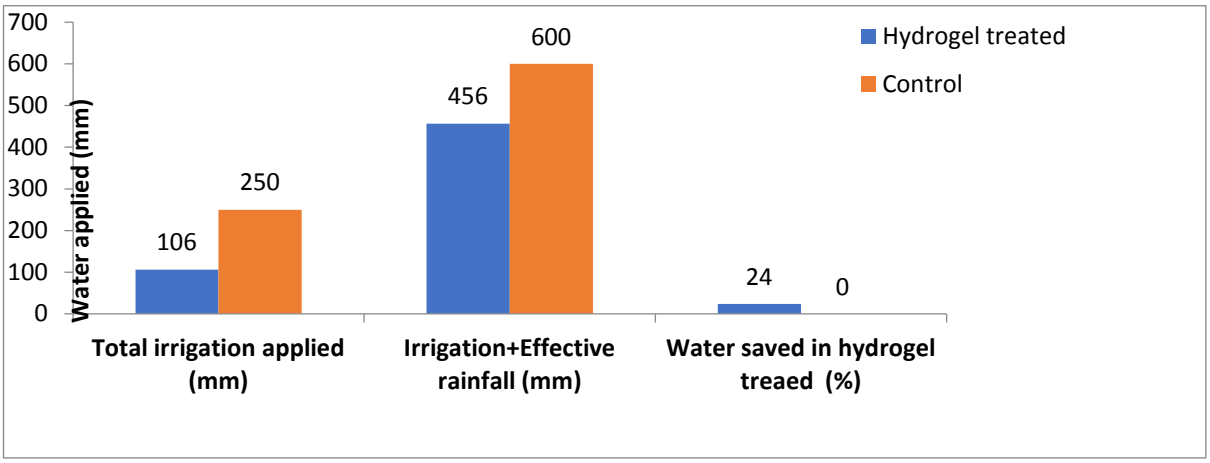



**Figure 30: Irrigation applied to the chilies**

## BARANI AGRICULTURAL RESEARCH STATION, FATEHJANG

### OVERVIEW

Pakistan has an agriculture-based economy and more than 38% of its labour depends for their income on agriculture in one way or the other. Wheat is major food crop of the people of Pakistan. Most of the wheat producing area in Pakistan is rainfed and any change in wheat yield in rainfed areas affect the overall wheat production and yield per acre of the country. Therefore, we need to develop high yielding varieties suitable for rainfed areas in order to get utmost production. Barani Agricultural Research Station Fatehjang was established during 1993 to accomplish this objective through the development of high yielding and drought tolerant genotypes of various crops for rainfed areas of Punjab. This research station has developed two high yielding, drought tolerant and disease resistant wheat varieties (BARS-09 & Fatehjang 2016) for the farmers of Barani tract of Punjab. The station planned research experiments for Rabi 2019-20 for the improvement of Rabi crops like wheat, chickpea, brassica and lentil. These crops are widely grown in Fatehjang and surrounding areas. During Rabi 2019-20, total 31 research experiments were conducted on wheat, chickpea, brassica and lentil. Data on agronomic traits, yield components and disease infestation were collected, statistically analyzed and conclusions were drawn for the advancement of further breeding programme.

### (A) WHEAT

#### 1. Enrichment, Maintenance and Evaluation of Wheat Gene Pool

Wheat gene pool comprising of 132 entries was sown in 2 rows of 3-meter length with 22.5 cm row spacing. The gene pool was sown on 04-11-2019 and harvested on 08-05-2020. Wheat germplasm was enriched by the addition of varieties/advanced lines of wheat from local (WRI Faisalabad, RARI, Bahawalpur, BARI Chakwal and NARC Islamabad) resources to accumulate diverse and desirable genes and to enhance genetic variability in our wheat gene pool. A good range of various traits is available in the gene pool which shows the presence of sufficient variability in the germplasm (Table1).

**Table 1: Wheat Genepool and Their Characteristics studied at BARS Fatehjang**

| Sr.No. | Character Studied | Range |
|---|---|---|
| 1 | Days to 50% heading | 102-138 days |
| 2 | Days to50% Maturity | 156-173 days |
| 3 | Plant height (cm) | 92-112 |
| 4 | Tillers / $m^2$ | 234-378 |
| 5 | No. of spikelets/ spike | 13-25 |
| 6 | No. of seeds per spike | 36-70 |
| 7 | 1000 seed weight (g) | 41-58 |
| 8 | Yield (kg/ha) | 2485-4815 |

## 2. Wheat Improvement Programme Through Hybridization

In total 116 crosses were attempted among selected genotypes and all successful crosses were harvested.

### Study of Filial Generations

Segregating populations were evaluated and promising plants/progenies were selected and advanced to next generation on the basis of morphological traits and disease resistance. The total numbers of entries studied and selected for further evaluation in next generations are given as below (Table 2):

**Table 2: Study of Filial Generations**

| Filial Generation | Entries studied | Entries Selected |
|---|---|---|
| Fresh Crosses | 116 attempted | 112 successful |

| | | |
|---|---|---|
| $F_1$ | 114 crosses | 110 crosses |
| $F_2$ | 102 Crosses | 52 Progenies |
| $F_3$ | 42 Progenies | 21 Progenies |
| $F_4$ | 33 Progenies | 18 Progenies |
| $F_5$ | 22 Progenies | 11 Progenies |
| $F_6$ | 12 Progenies | 05 Progenies (18 lines) |
| **Total entries** | **325 ($F_1$-$F_6$)** | **217 ($F_1$-$F_6$)** |

## 3. Evaluation of Wheat Screening Nurseries / Trials

Total five different trials and nurseries were received from CIMMYT which were studied during Rabi 2019-20 at this station under rainfed conditions. Standard agronomic practices were performed for the evaluation of these nurseries / trials. A total of 697 entries were screened and 94 promising lines were selected having desirable traits, out of which 18 entries were included in Preliminary Yield Trials. Detail of entries is given below (Table 3):

**Table: 3 Wheat Screening Nurseries / Trials**

| Sr. No. | Nursery | Entries | |
|---|---|---|---|
| | | Studied | Selected |
| 1 | 37th Semi Arid Wheat Screening Nursery | 283 | 30 |
| 2 | 52nd International Bread Wheat screening Nursery | 284 | 24 |
| 3 | 27th Semi Arid Wheat Yield Trial | 50 | 16 |
| 4 | 40th Elite Selection Wheat Yield Trial | 50 | 14 |
| 5 | 9SATYNDRGHT | 30 | 10 |
| **TOTAL** | | **697** | **94** |

## 4. Preliminary Wheat Yield Trials (A-Trials)

Forty-eight wheat entries along with two check varieties (Fatehjang-2016 & BARS-09) were evaluated for their yield performance and disease resistance in two A-Trials. The trials were sown on 04-11-2019 on plot size of 3.6 $m^2$ in Alpha Lattice with two replications and harvested on 14-05-2020. The yield data is given below (Table 4):

**Table:4 Grain Yield (kg/ha) A-I**

| Sr. No./ Rank-ing | Entry Name | Yield (kg/ha) | Sr. No./ Ranking | Entry Name | Yield (kg/ha) |
|---|---|---|---|---|---|
| 1 | 18FJ19 | 8013.89a | 14 | 18FJ09 | 5972.22de |
| 2 | 18FJ07 | 6895.83b | 15 | 18FJ15 | 5861.11e |
| 3 | 18FJ21 | 6736.11b | 16 | 18FJ10 | 5791.67ef |
| 4 | 18FJ13 | 6701.39bc | 17 | 18FJ04 | 5715.28ef |
| 5 | 18FJ01 | 6645.83c | 18 | 18FJ20 | 5638.89f |
| 6 | 18FJ22 | 6548.61c | 19 | 18FJ17 | 5576.39fg |
| 7 | 18FJ16 | 6472.22c | 20 | 18FJ18 | 5444.44fg |
| 8 | 18FJ06 | 6402.78cd | 21 | 18FJ12 | 5250.00g |
| 9 | 18FJ08 | 6201.39d | 22 | 18FJ03 | 5104.17gh |
| 10 | 18FJ11 | 6180.56d | 23 | **BARS-09** | **5076.39h** |
| 11 | 18FJ24 | 6159.72d | 24 | 18FJ14 | 4673.61i |
| 12 | **FJ-16** | **6090.28de** | 25 | 18FJ23 | 4520.83ij |
| 13 | 18FJ05 | 5979.17de | 26 | 18FJ02 | 3861.11j |
| **LSD = 187.12** | | | **CV = 4.37** | | |

The results showed that 18FJ19 (8013.89 kg/ha) exceeded all the genotypes followed by 18FJ07 (6895.83 kg/ha). The lowest grain yield was observed in 18FJ02 (3861.11 kg/ha) in Table 5.

**Table 5: Grain Yield (kg/ha) A-II**

| Sr. No./ ranking | Entry name | Yield (kg/ha) | Sr. No./ ranking | Entry name | Yield (kg/ha) |
|---|---|---|---|---|---|
| 1 | 18FJ25 | 6465.28a | 14 | 18FJ27 | 4506.94g |
| 2 | 18FJ33 | 6152.78b | 15 | 18FJ42 | 4409.72g |
| 3 | 18FJ30 | 5784.72c | 16 | 18FJ28 | 4166.67gh |
| 4 | 18FJ26 | 5770.83c | 17 | 18FJ38 | 4166.67gh |
| 5 | 18FJ29 | 5625.00cd | 18 | 18FJ43 | 4111.11gh |
| 6 | 18FJ31 | 5548.61cd | 19 | 18FJ40 | 4013.89h |
| 7 | 18FJ34 | 5375.00d | 20 | **BARS-09** | **3750.00i** |

| | | | | | |
|---|---|---|---|---|---|
| 8 | 18FJ41 | 5291.67d | 21 | 18FJ47 | 3687.50i |
| 9 | 18FJ32 | 5180.56de | 22 | 18FJ46 | 3645.83ij |
| 10 | **FJ-16** | **5013.89e** | 23 | 18FJ39 | 3576.39j |
| 11 | 18FJ35 | 5000.00e | 24 | 18FJ48 | 3013.89k |
| 12 | 18FJ36 | 4736.11f | 25 | 18FJ45 | 2875.00l |
| 13 | 18FJ37 | 4645.83fg | 26 | 18FJ44 | 2590.28m |
| **LSD = 174.39** | | | **CV = 6.12** | | |

The results indicated that 18FJ25 (6465.28 kg/ha) exceeded all the genotypes followed by 18FJ33 (6152.78 kg/ha). The lowest grain yield was observed in 18FJ44 (2590.28 kg/ha).

## 5. Regular Wheat Yield Trial

Twenty-two lines of wheat along with two checks (Fatehjang-2016 & BARS-09) were evaluated in regular wheat yield trial according to alpha lattice design in two replications. The experiment was sown on 04-11-2019 on plot size of 3.6 $m^2$ with 22.5 cm row spacing. The trial was harvested on 14-05-2020. The results are presented below in Table 6:

**Table 6: Grain Yield (Kg/ha) B-Trial**

| Sr. No./ ranking | Entry name | Yield (kg/ha) | Sr. No./ ranking | Entry name | Yield (kg/ha) |
|---|---|---|---|---|---|
| 1 | 17FJ16 | 7055.56a | 12 | 17FJ09 | 4472.22hi |
| 2 | 17FJ10 | 6451.39b | 13 | 17FJ23 | 4430.56i |
| 3 | 17FJ05 | 6215.28c | 14 | 17FJ15 | 4312.50i |
| 4 | **FJ-16** | **5791.67d** | 15 | 17FJ35 | 4277.78ij |
| 5 | 17FJ11 | 5368.06e | 16 | 17FJ33 | 4125.00j |
| 6 | **BARS-09** | **5055.56f** | 17 | 17FJ29 | 4097.22j |
| 7 | 17FJ07 | 4819.44g | 18 | 17FJ28 | 3958.33jk |
| 8 | 17FJ03 | 4666.67h | 19 | 17FJ32 | 3958.33jk |
| 9 | 17FJ24 | 4548.61h | 20 | 17FJ18 | 3895.83k |
| 10 | 17FJ30 | 4506.94hi | 21 | 17FJ22 | 3305.56l |
| 11 | 17FJ17 | 4479.17hi | 22 | 17FJ21 | 3027.78m |

| LSD = 198.33 | CV = 5.28 |
|---|---|

The data showed that the three genotypes exceeded all the genotypes in grain yield and performed better than both checks. Among those, 17FJ16 (7055.56 kg/ha) ranked first followed by 17FJ10 (6451.39 kg/ha) while 17FJ21 produced lowest grain yield (3027.78 kg/ha).

## 6. Punjab Uniform Wheat Yield Trial

The trial was received from Wheat Research Institute, Ayub Agricultural Research Institute, Faisalabad. It comprised of 50 entries. The trial was sown on 04-11-2019 in Alpha Lattice Design with two replications. Each entry was sown in a plot size of 4.5 $m^2$ (0.9m x 5m), with row spacing of 22.5cm. The trial was harvested on 15-05-2020. Grain yield data were recorded (Table 7) and sent to quarter concerned.

**Table 7: Grain Yield (kg/ha)**

| S. No./ Ranking | V. Code | Yield (kg/ha) | S. No./ Ranking | V. Code | Yield (kg/ha) |
|---|---|---|---|---|---|
| 1 | 10 | 8661.11a | 26 | 33 | 5794.44hi |
| 2 | 14 | 8155.56b | 27 | 42 | 5672.22hi |
| 3 | 41 | 7300.00c | 28 | 26 | 5561.11i |
| 4 | 22 | 7116.67cd | 29 | 39 | 5555.56i |
| 5 | 6 | 7050.00d | 30 | 35 | 5538.89i |
| 6 | 43 | 6844.44de | 31 | 1 | 5516.67i |
| 7 | 16 | 6783.33e | 32 | 13 | 5455.56i |
| 8 | 28 | 6666.67e | 33 | 23 | 5422.22ij |
| 9 | 25 | 6555.56ef | 34 | 7 | 5400.00ij |
| 10 | 5 | 6516.67ef | 35 | 49 | 5266.67j |
| 11 | 11 | 6466.67ef | 36 | 34 | 5222.22j |
| 12 | 44 | 6461.11ef | 37 | 45 | 5205.56j |
| 13 | 37 | 6444.44ef | 38 | 17 | 5077.78k |
| 14 | 36 | 6416.67f | 39 | 48 | 5055.56k |
| 15 | 2 | 6350.00f | 40 | 50 | 4944.44k |
| 16 | 20 | 6322.22f | 41 | 8 | 4927.78kl |

| | | | | | |
|---|---|---|---|---|---|
| 17 | 21 | 6238.89fg | 42 | 29 | 4911.11kl |
| 18 | 46 | 6161.11g | 43 | 40 | 4544.44l |
| 19 | 18 | 6144.44g | 44 | 30 | 4433.33lm |
| 20 | 31 | 6061.11gh | 45 | 4 | 4422.22lm |
| 21 | 15 | 6050.00gh | 46 | 32 | 4416.67lm |
| 22 | 12 | 6027.78gh | 47 | 47 | 4322.22m |
| 23 | 19 | 5844.44h | 48 | 9 | 4283.33mn |
| 24 | 24 | 5844.44h | 49 | 38 | 4250.00mn |
| 25 | 27 | 5805.56h | 50 | 3 | 4000.00n |
| **LSD = 254.32** | | | | **CV = 7.21** | |

The data in the above table indicated that the genotype No. 10 exceeded all the entries in the trial by producing highest grain yield (8611.11 kg/ha) followed by the genotypes No. 14 (8155.56 kg/ha) while the lowest yield was produced was genotype No. 03 (4000.00 kg/ha).

## 7. National Uniform Wheat Yield Trial

The trial was received from Coordinator Wheat, PARC Islamabad, comprised of 60 entries including one local check (Fatehjang-2016). This trial was sown on 11-11-2019 in Alpha Lattice Design with two replications. Each entry was sown in plot size of 5.625 $m^2$ (1.125m x 5.0m), with row spacing of 22.5 cm. This trial was harvested on 14-05-2020. Grain yield data was recorded (Table 8) and sent to quarter concerned:

**Table 8: Grain Yield (Kg/ha) NUWYT**

| Sr. No. | NUWYT Plot No. | Yield (kg/ha) | Sr. No. | NUWYT Entry No. | Yield (kg/ha) | Sr. No. | NUWYT Entry No. | Yield (kg/ha) |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 5546.67 | 41 | 41 | 5520.00 | 81 | 81 | 6995.56 |
| 2 | 2 | 6204.44 | 42 | 42 | 5724.44 | 82 | 82 | 6631.11 |
| 3 | 3 | 6613.33 | 43 | 43 | 5520.00 | 83 | 83 | 6017.78 |
| 4 | 4 | 5200.00 | 44 | 44 | 6888.89 | 84 | 84 | 6551.11 |
| 5 | 5 | 6915.56 | 45 | 45 | 6355.56 | 85 | 85 | 5075.56 |
| 6 | 6 | 6951.11 | 46 | 46 | 5102.22 | 86 | 86 | 6115.56 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7 | 7 | 7164.44 | 47 | 47 | 5315.56 | 87 | 87 | 5982.22 |
| 8 | 8 | 6995.56 | 48 | 48 | 5600.00 | 88 | 88 | 6435.56 |
| 9 | 9 | 6631.11 | 49 | 49 | 5600.00 | 89 | 89 | 6204.44 |
| 10 | 10 | 6017.78 | 50 | 50 | 5057.78 | 90 | 90 | 6613.33 |
| 11 | 11 | 6551.11 | 51 | 51 | 5422.22 | 91 | 91 | 6142.22 |
| 12 | 12 | 5075.56 | 52 | 52 | 5404.44 | 92 | 92 | 5413.33 |
| 13 | 13 | 6115.56 | 53 | 53 | 4755.56 | 93 | 93 | 6702.22 |
| 14 | 14 | 5982.22 | 54 | 54 | 6613.33 | 94 | 94 | 7004.44 |
| 15 | 15 | 6435.56 | 55 | 55 | 5946.67 | 95 | 95 | 5431.11 |
| 16 | 16 | 6204.44 | 56 | 56 | 5555.56 | 96 | 96 | 5644.44 |
| 17 | 17 | 6613.33 | 57 | 57 | 4284.44 | 97 | 97 | 5964.44 |
| 18 | 18 | 6142.22 | 58 | 58 | 4888.89 | 98 | 98 | 5724.44 |
| 19 | 19 | 5413.33 | 59 | 59 | 5777.78 | 99 | 99 | 5484.44 |
| 20 | 20 | 6702.22 | 60 | 60 | 5608.89 | 100 | 100 | 5404.44 |
| 21 | 21 | 7004.44 | 61 | 61 | 6204.44 | 101 | 101 | 4755.56 |
| 22 | 22 | 5431.11 | 62 | 62 | 6613.33 | 102 | 102 | 6613.33 |
| 23 | 23 | 5644.44 | 63 | 63 | 6142.22 | 103 | 103 | 5946.67 |
| 24 | 24 | 5964.44 | 64 | 64 | 5413.33 | 104 | 104 | 5555.56 |
| 25 | 25 | 5724.44 | 65 | 65 | 6702.22 | 105 | 105 | 4284.44 |
| 26 | 26 | 5484.44 | 66 | 66 | 7004.44 | 106 | 106 | 4888.89 |
| 27 | 27 | 5591.11 | 67 | 67 | 5431.11 | 107 | 107 | 5777.78 |
| 28 | 28 | 6097.78 | 68 | 68 | 5644.44 | 108 | 108 | 5608.89 |
| 29 | 29 | 5804.44 | 69 | 69 | 5964.44 | 108 | 108 | 6204.44 |
| 30 | 30 | 5644.44 | 70 | 70 | 5724.44 | 110 | 110 | 6613.33 |
| 31 | 31 | 5360.00 | 71 | 71 | 5484.44 | 111 | 111 | 6142.22 |
| 32 | 32 | 6773.33 | 72 | 72 | 5591.11 | 112 | 112 | 5413.33 |
| 33 | 33 | 5404.44 | 73 | 73 | 6097.78 | 113 | 113 | 6702.22 |
| 34 | 34 | 5706.67 | 74 | 74 | 5804.44 | 114 | 114 | 7004.44 |
| 35 | 35 | 5457.78 | 75 | 75 | 5644.44 | 115 | 115 | 5431.11 |
| 36 | 36 | 6053.33 | 76 | 76 | 5360.00 | 116 | 116 | 6017.78 |
| 37 | 37 | 7226.67 | 77 | 77 | 6773.33 | 117 | 117 | 6551.11 |
| 38 | 38 | 5751.11 | 78 | 78 | 5404.44 | 118 | 118 | 5075.56 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 39 | 39 | 6213.33 | 79 | 79 | 6951.11 | 119 | 119 | 6115.56 |
| 40 | 40 | 5253.33 | 80 | 80 | 7164.44 | 120 | 120 | 5706.67 |

The data in the above table indicated that the Entry No. 37 exceeded all the entries in the trial by producing highest grain yield (7226.67kg/ha) followed by the genotypes No. 7 (7164.44 kg/ha) while the lowest yield was produced was genotype No. 57 (5284.44 kg/ha)

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**8. National Uniform Durum Wheat Yield Trial**

The trial was received from Coordinator Wheat, PARC Islamabad, comprised of 19 entries. This trial was sown on 11-11-2019 in Alpha Lattice Design with two replications. Each entry was sown in plot size of 5.625 $m^2$ (1.125m x 5.0m), with row spacing of 22.5 cm. This trial was harvested on 15-05-2020. Grain yield data was recorded (Table 9) and sent to quarter concerned:

**Table 9: Grain Yield (kg/ha)**

| Sr. No./ ranking | Entry name | Yield (kg/ha) | Sr. No./ ranking | Entry name | Yield (kg/ha) |
|---|---|---|---|---|---|
| 1 | 4 | 2804.44a | 11 | 16 | 2368.89cd |
| 2 | 1 | 2657.78b | 12 | 13 | 2351.11cd |
| 3 | 10 | 2640.00b | 13 | 19 | 2351.11cd |
| 4 | 14 | 2493.33bc | 14 | 18 | 2337.78cd |
| 5 | 2 | 2462.22bc | 15 | 12 | 2311.11cd |
| 6 | 17 | 2462.22bc | 16 | 15 | 2284.44d |
| 7 | 11 | 2448.89c | 17 | 8 | 2257.78d |
| 8 | 6 | 2435.56c | 18 | 3 | 2168.89de |
| 9 | 5 | 2422.22c | 19 | 7 | 2115.56de |
| 10 | 9 | 2373.33cd | | | |
| **LSD = 174.55** | | | | **CV = 4.18** | |

**9. Seed Rate Studies in Different Genotypes of Wheat**

The study was designed to determine the effect of different seed rates on yield of advance wheat lines. Two genotypes with 4 seed rates were sown on 13-11-2019 in four rows of 4 m length**.** Row to row spacing was kept as 30 cm.

Genotypes **V1** = Fatehjang-2016, **V2** =15FJ05

Seeding rates S1 = 75 kg/ha S2 =100 kg/ha

S3 =125 kg/ha S4 =150 kg/ha

The trial was harvested on 15-05-2020. Yield data is given below in Table 10:

**Table 10: Yield data of Different Genotypes Of Wheat**

| Seed Rate | Grain Yield (kg/ha) | | Mean |
|---|---|---|---|
| | **FJ-16** | **15FJ05** | |
| 75 Kg/ha | 5604.17 | 5732.64 | 5668 |
| 100 Kg/ha | 6774.31 | 6982.64 | 6878 |
| **125 Kg/ha** | **7635.42** | **7850.69** | 7743 |
| 150 Kg/ha | 6503.47 | 6552.08 | 6528 |
| Mean | 6629 | 6780 | |
| LSD (0.05) Seed Rate = 276.34<br>LSD (0.05) Genotype = 214.52<br>LSD (0.05) Genotype x Seed rate = 423.72<br>CV% = 4.81 | | | |

The data showed that genotype 15FJ05 with seed rate of 125kg/ha exceeded all the treatments in grain yield (7850.69 kg/ha).

## 10. Sowing Date Studies in Different Genotypes of Wheat

To find out the best sowing date for getting maximum yield under rain-fed conditions, genotypes 15FJ05 and Fatehjang-2016 were sown on following five different dates:

Genotypes

**V1**= Fatehjang-2016, **V2**= 15FJ05

Sowing Dates

T1= 25/10/19 T4= 25/11/19

T2= 05/11/19 T5= 05/12/19

T3= 15/11/19 T6= 15/12/19

Each entry was sown in a plot size of 1.2m x 4m in factorial. The trial was harvested on 15-05-2020 and yield data were recorded and show in Table 11 below:-

**Table 11: Yield data of Different Genotypes of Wheat**

| Sowing Dates | Grain Yield (kg/ha) | | Mean |
|---|---|---|---|
| | FJ-16 | 15FJ05 | |
| **25-10-2019** | **7906.25** | **7993** | 7950 |
| 05-11-2019 | 7152.78 | 7392 | 7273 |
| 15-11-2019 | 6600.69 | 6722 | 6661 |
| 25-11-2019 | 5534.72 | 5660 | 5597 |
| 05-12-2019 | 5322.92 | 5302 | 5313 |
| 15-12-2019 | 4885.42 | 5035 | 4960 |
| Mean | 6234 | 6351 | |
| LSD (0.05) Sowing Date = 208.31<br>LSD (0.05) Genotype = 125.45<br>LSD (0.05) Genotype x Sowing Date = 285.33<br>CV% = 6.72 | | | |

The results revealed that genotype 15FJ05 with sowing date of 25-10-2019 gave the highest yield (7993 kg/ha).

## 11. Fertilizer Dose Studies in Different Genotype of Wheat

Study was designed to determine the effect of different fertilizer doses on advance wheat line. Two genotypes with five (5) fertilizer treatments were sown on 13-11-2019 in four rows of 4m lengths.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Genotypes | | **V1** | = | Fatehjang-2016 | | **V2** | = | 15FJ05 | | |
| Fertilizer dose | | | **N** | **P** | **K** | **N** | **P** | **K** | | |
| F1 | = | 0 | 0 | 0 | | F2 | = | 30 | 30 | 0 |
| F3 | = | 60 | 30 | 30 | | F4 | = | 90 | 60 | 30 |
| F5 | = | 120 | 90 | 60 | | | | | | |

The trial was harvested on 15-05-2020. Yield data is presented in table given below Table 12:

**Table 12: Yield Data of fertilizer doses**

| Fertilizer dose N:P: K | Grain Yield (kg/ha) | | Mean |
|---|---|---|---|
| | FJ-16 | 15FJ05 | |
| 0:00:00 | 6361 | 6388.89 | 6375 |
| 30:30:00 | 6559 | 6659.72 | 6609 |
| 60:30:30 | 6826 | 6802.08 | 6814 |
| **90:60:30** | **7816** | **8045.14** | 7931 |
| 120:90:60 | 6378 | 6503.47 | 6441 |
| **Mean** | 6788 | 6880 | |
| LSD (0.05) Fertilizer Dose = 175.42<br>LSD (0.05) Genotype = 106.59<br>LSD (0.05) Genotype x Fertilizer Dose = 227.51<br>CV% = 5.26 | | | |

The results presented above revealed that genotype 15FJ05 with fertilizer dose of 90-60-30 NPK gave the highest yield of 8045.14 kg/ha.

### 12. Evaluation of Wheat Candidate Line 15FJ05 at the Farmer' Field

A study was designed to evaluate the yield performance of candidate wheat line 15FJ05 at farmer's fields. Two genotypes were sown on 25-10-2019 on plot size of 4 kanals each at three different locations. All the standard agronomic practices were carried out. The trial was harvested on 15-05-2020. Yield data is presented in table 13 given below:

**Table 13: Yield data of Wheat Candidate Line 15FJ05**

| Variety/Line | Yield (kg/ha) | | | |
|---|---|---|---|---|
| | Fatehjang | Jand | Pindigheb | Mean |
| Fatehjang-2016 | 4125 | 3645 | 3940 | 3903 |
| 15FJ05 | 4620 | 3955 | 4370 | **4315** |

The results presented above revealed that genotype 15FJ05 performed better than check variety Fatehjang-2016 by producing higher mean yield of 4315 kg/ha.

### 13. Nucleus Seed Production

To maintain the purity and to produce true-to-type seed of commercial varieties and advance lines of wheat. Following selections were made as shown in Table 14: -

**Table 14: Selections made Nucleus Seed Production**

| Sr. No. | Variety / Line | Heads selected | Rows sown | Rows selected | Blocks sown | Blocks Selected |
|---|---|---|---|---|---|---|
| 1 | BARS-09 | 150 | 150 | 10 | 10 | - |
| 2 | Fatehjang-2016 | 200 | 200 | 20 | 20 | - |

**B: CHICKPEA**

**14. Maintenance of Chickpea (Kabuli) Genepool**

Chickpea (Kabuli) gene pool consisting of 176 varieties/advance lines was sown on 30-10-2019 in single row of 4m length and harvested on 19-05-2020. These genotypes were evaluated for their resistance against blight and various yield related traits were also recorded in Table 15 under natural conditions.

**Table 15: Maintenance of Chickpea (Kabuli) Genepool**

| Sr. No. | Character Studied | Range |
|---|---|---|
| 1 | Plant height (cm) | 45-102 |
| 2 | Days to flowering (50%) | 85-106 |
| 3 | Primary branches/plant | 4-7 |
| 4 | Secondary branches/plant | 10-30 |
| 5 | Pods/plant | 27-52 |
| 6 | No. of seeds/ pod | 1-3 |
| 7 | Days to maturity (90%) | 185-207 |
| 8 | 100 seed weight (g) | 15-27 |
| 9 | Seed yield (kg/ha) | 645-1050 |

**15.Chickpea (Kabuli) Improvement Programme Through Hybridization**

Fifteen (15) crosses were performed among selected genotypes to incorporate cold tolerance and blight resistance in Kabuli Chickpea. However, 05 out of 15 were successful. Segregating populations of chickpea were evaluated against blight resistant and plants/progenies were selected and advanced to next generation. The detail of filial generations is as under in Table16:

**Table 16: Detail of Filial Generations**

| Filial generation | Entries studied | Entries selected |
|---|---|---|
| Fresh crosses | 15 attempted | 05 successful |
| $F_1$ | 22 crosses | 15 crosses |
| $F_2$ | 15 progenies | 08 progenies |
| $F_3$ | 05 progenies | 03 progenies |
| $F_5$ | 4 (SPS) progenies | 06 (SPS) progenies |

## 16. Evaluation of Chickpea Screening Nurseries

One chickpea Ascochyta Blight screening nursery was received from NIAB, Faisalabad during Rabi 2019-20 at the station under rainfed conditions that was comprised of 58 entries out of which 5 entries were selected. Standard agronomic practices were performed for the evaluation of these nurseries. Details of entries are given below Table 17:-

**Table 17: Chickpea Nurseries Screened at BARS Fatehjang**

| Sr. No. | Nursery | Entries | |
|---|---|---|---|
| | | Studied | Selected |
| 1 | Chickpea (k) Ascochyta Blight Screening Nursery 2019-20 | 58 | 05 |

## 17.Chickpea (K) Preliminary Yield Trial (A-Trial) 2019-20

Twenty chickpea entries including two check varieties (Tamman 13 & Noor-2013) were evaluated in Preliminary yield trial for their yield performance and disease resistance. The trial was sown on 30-10-2019 on plot size of 7.2 $m^2$ in RCBD with three replications and harvested on 18-05-2020. The yield data is given below Table 18:

**Table 18: Grain Yield (kg/ha) A-Trial**

| Rank-ing | Entry Code | Yield (kg/ha) | Ranking | Entry Code | Yield (kg/ha) |
|---|---|---|---|---|---|
| 1 | 19FCK01 | 983.33a | 11 | 19FCK09 | 789.58cd |
| 2 | 19FCK11 | 868.75b | 12 | 19FCK07 | 786.46d |
| 3 | 19FCK03 | 833.33b | 13 | 19FCK16 | 783.33d |
| 4 | 19FCK06 | 822.92bc | 14 | 19FCK13 | 771.88d |
| 5 | 19FCK12 | 822.92bc | 15 | 19FCK02 | 756.25de |
| 6 | 19FCK18 | 820.83bc | 16 | 19FCK10 | 755.21de |
| 7 | 19FCK15 | 811.46c | 17 | **Noor-13** | **742.71de** |
| 8 | 19FCK08 | 801.04c | 18 | 19FCK05 | 736.46de |
| 9 | **Tamman-13** | **791.67cd** | 19 | 19FCK04 | 734.38de |
| 10 | 19FCK14 | 790.63cd | 20 | 19FCK17 | 708.33e |
| **CV= 6.15** | | | **LSD=54.185** | | |

The results indicated that the entry 19FCK01 exceeded all the genotypes by producing maximum yield (983.33 kg/ha) followed by 19FCK11 (868.75 kg/ha) while lowest grain yield was observed in 19FCK17 (708.33 kg/ha).

**18.Chickpea (K) Regular Yield Trial (B-Trial) 2019-20**

Ten chickpea entries including two check varieties (Tamman-13 & Noor-13) were evaluated for their yield performance and disease resistance in B-Trial. The trial was sown on 30-10-2019 on plot size of 7.2 $m^2$ in RCBD with three replications and harvested on 18-05-2020. The yield data is given below in Table 19:-

**Table 19: Yield Data of Regular Yield Trial**

| Sr. No/Ranking | Entry Code | Yield (kg/ha) |
|---|---|---|
| 1 | 18FCK02 | 873.96a |
| 2 | 18FCK13 | 836.46ab |
| 3 | **Tamman-13** | **801.04b** |
| 4 | 18FCK01 | 790.63b |
| 5 | 18FCK03 | 766.67bc |
| 6 | 18FCK09 | 751.04bc |
| 7 | **Noor-13** | **747.92bc** |

| | | |
|---|---|---|
| 8 | 18FCK18 | 740.63c |
| 9 | 18FCK04 | 729.17cd |
| 10 | 18FCK17 | 697.92d |
| **CV= 5.37** | **LSD=38.333** | |

The results indicated that the entry 18FCK02 exceeded all the genotypes by producing maximum yield (873.96 kg/ha) followed by 18FCK13 (836.46 kg/ha) while lowest grain yield was observed in 18FCK17 (697.92 kg/ha).

**19. Chickpea Micro Yield Trial (Kabuli) 2019-20**

The trial was received from BARI, Chakwal to evaluate the comparative performance of 13 entries under various ecological conditions. The experiment was sown on 22-10-2019 using Randomized Complete Block Design with three replications having a plot size of 4m x 1.2m. It was harvested on 21-05-2020. Grain yield data were recorded (Table 20) and sent to quarter concerned.

**Table 20: Grain Yield Data Chickpea Micro Yield Trial (Kabuli)**

| Sr. No/ Ranking | Name/Code | Grain Yield (kg/ha) | Sr. No/ Ranking | Name/Code | Grain Yield (kg/ha) |
|---|---|---|---|---|---|
| **1** | 17KCC118 | 759.03a | **8** | 17KCC109 | 679.17c |
| 2 | 17FCK05 | 732.64b | 9 | 17KCC102 | 677.08c |
| 3 | 17KCC114 | 719.44b | 10 | 17KCC112 | 676.39c |
| 4 | Tamman-13 | 703.47bc | 11 | 17KCC107 | 675.69c |
| 5 | 17KCC106 | 699.31bc | 12 | 17KCC104 | 674.31c |
| 6 | 17KCC113 | 690.97bc | 13 | 17KCC120 | 649.31cd |
| **7** | Noor-13 | 680.56c | | | |
| **CV= 7.75** | | | **LSD= 28.618** | | |

The results indicated that the entry 17KCC118 exceeded all the genotypes by producing maximum yield (759.03 kg/ha) followed by 17FCK05 (732.64 kg/ha) while lowest grain yield was observed in 17KCC120 (649.31 kg/ha).

## 20.Chickpea Cooperative Yield Trial (Kabuli) 2019-20

The trial was received from PRI, Faisalabad to evaluate the comparative performance of 20 entries under various ecological conditions. The experiment was sown on 23-10-2019 using Randomized Complete Block Design with three replications having a plot size of 4m x 1.2m. It was harvested on 22-05-2020. Grain yield data were recorded (Table 21) and sent to quarter concerned.

**Table 21: Grain Yield Data Chickpea Cooperative Yield Trial (Kabuli)**

| Sr. No/ Ranking | Name/Code | Grain Yield (kg/ha) | Sr. No/ Ranking | Name/Code | Grain Yield (kg/ha) |
|---|---|---|---|---|---|
| 1 | R | 733.33a | 11 | G | 693.06b |
| 2 | P | 728.47a | 12 | C | 686.11b |
| 3 | J | 722.92a | 13 | F | 684.03bc |
| 4 | T | 718.75a | 14 | M | 682.64bc |
| 5 | Q | 715.28ab | 15 | B | 681.25bc |
| 6 | K | 710.42ab | 16 | S | 680.56bc |
| 7 | I | 707.64ab | 17 | O | 675.69c |
| 8 | N | 702.78ab | 18 | A | 670.83c |
| 9 | D | 698.61b | 19 | H | 663.19cd |
| 10 | E | 695.83b | 20 | L | 660.42cd |
| **CV=5.48** | | | **LSD=23.15** | | |

The results indicated that the entry R exceeded all the genotypes by producing maximum yield (733.33 kg/ha) followed by entry P (728.47 kg/ha) while minimum yield was observed in entry L (660.42 kg/ha).

## 21.Chickpea National Uniform Yield Trial (K) 2019-20

The trial was received from NARC, Islamabad to evaluate the comparative performance of 16 entries under rainfed conditions. The experiment was sown on 30-10-2019 using Randomized Complete Block Design with three replications having a plot size of 4m x 1.2m. It was harvested on 20-05-2020. Grain yield data were recorded (Table 22) and sent to quarter concerned.

**Table 22: Grain yield Chickpea National Uniform Yield Trial (K) 2019-20**

| Sr. No/ Ranking | Name/Code | Grain Yield (kg/ha) | Sr. No/ Ranking | Name/Code | Grain Yield (kg/ha) |
|---|---|---|---|---|---|
| 1 | 13 | 784.03a | 9 | 1 | 725.69c |
| 2 | 10 | 779.17a | 10 | 14 | 722.92c |
| 3 | 8 | 768.06a | 11 | 15 | 713.89cd |
| 4 | 4 | 760.42ab | 12 | 7 | 711.11cd |
| 5 | 3 | 742.36b | 13 | 9 | 697.92d |
| 6 | 6 | 741.67b | 14 | 2 | 679.17de |
| 7 | 11 | 730.56bc | 15 | 5 | 666.67de |
| 8 | 12 | 729.86bc | 16 | 16 | 659.72e |
| **CV= 6.55** | | | | **LSD= 30.25** | |

The results indicated that the entry no. 13 exceeded all the genotypes by producing maximum yield (784.03 kg/ha) followed by entry no. 10 (779.17 kg/ha) while lowest yield was noted in entry no. 16 (659.72 kg/ha).

**22. Chickpea National Uniform Yield Trial (D) 2019-20**

The trial was received from NARC, Islamabad to evaluate the comparative performance of 19 entries under various ecological conditions. The experiment was sown on 30-10-2019 using Randomized Complete Block Design with three replications having a plot size of 4m x 1.2m. It was harvested on 20-05-2020. Grain yield data were recorded and sent to quarter concerned.

**Table 23: Grain yield Chickpea National Uniform Yield Trial (K) 2019-20**

| Sr. No/ Ranking | Name/Code | Grain Yield (kg/ha) | Sr. No/ Ranking | Name/ Code | Grain Yield (kg/ha) |
|---|---|---|---|---|---|
| 1 | 12 | 681.94a | 11 | 15 | 625.69c |
| 2 | 1 | 672.92a | 12 | 8 | 618.06cd |
| 3 | 11 | 664.58a | 13 | 3 | 600.00d |
| 4 | 9 | 662.50ab | 14 | 10 | 593.06de |
| 5 | 7 | 652.78b | 15 | 17 | 590.97de |
| 6 | 14 | 649.31b | 16 | 16 | 580.56e |
| 7 | 2 | 643.75bc | 17 | 4 | 575.00e |
| 8 | 13 | 635.42c | 18 | 5 | 543.06f |
| 9 | 18 | 628.47c | 19 | 19 | 535.42f |

| | | | | | |
|---|---|---|---|---|---|
| 10 | 6 | 627.08c | | | |
| **CV=7.42** | | | | **LSD=23.117** | |

The results indicated that the entry no. 12 exceeded all the genotypes by producing maximum yield (681.94 kg/ha) followed by entry no. 01 (672.92 kg/ha) while lowest yield was noted in entry no. 19 (532.42 kg/ha).

## (C) LENTIL

### 23. Lentil Micro Yield Trial 2019-20

The trial was received from PRI, Faisalabad comprising of 14 entries. The trial was sown on 22-10-2019 in a Randomized Complete Block Design with three replications. The plot size was kept 4.8 $m^2$ (1.2m x 4.0m) with row spacing of 30cm. The trial was harvested on 07-05-2020. Grain yield data were recorded and sent to quarter concerned. The results indicated that the entry B exceeded all the genotypes by producing maximum yield (1015.28 kg/ha) followed by entry E (1003.47 kg/ha) while lowest yield was noted in entry N (888.89 kg/ha) as shown in Table 24.

**Table 24: Grain yield Lentil Micro Yield Trial 2019-20**

| Sr. No/ Ranking | Name/Code | Grain Yield (kg/ha) | Sr. No/ Ranking | Name/Code | Grain Yield (kg/ha) |
|---|---|---|---|---|---|
| 1 | B | 1015.28a | 8 | C | 950.69bc |
| 2 | E | 1003.47a | 9 | H | 941.67c |
| 3 | A | 997.22a | 10 | J | 931.94cd |
| 4 | L | 990.97ab | 11 | G | 926.39cd |
| 5 | M | 972.22ab | 12 | D | 918.75d |
| 6 | F | 968.06b | 13 | K | 913.89d |
| 7 | I | 965.97b | 14 | N | 888.89de |
| **CV=8.25** | | | | **LSD= 33.855** | |

### 24. Lentil Micro Yield Trial 2019-20

The trial was received from BARI, Chakwal comprising of 12 entries. The trial was sown on 22-10-2019 in a Randomized Complete Block Design with three replications. The plot size was kept 4.8 $m^2$ (1.2m x 4.0m) with row spacing of 30cm. The trial was harvested on 08-05-2020. Grain yield data were recorded and sent to quarter concerned as shown in Table 25.

**Table 25: Grain Yield of Lentil Micro Yield Trial 2019-20**

| Sr. No/ Ranking | Name/Code | Grain Yield (kg/ha) | Sr. No/ Ranking | Name/Code | Grain Yield (kg/ha) |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| 1 | 17CL-308 | 1234.72a | 8 | CH Masoor | 1159.03bc |
| 2 | 17CL-305 | 1204.17a | 9 | 17CL-301 | 1157.64bc |
| 3 | 17CL-302 | 1179.86b | 10 | 17CL-303 | 1149.31c |
| 4 | 17CL-309 | 1171.53b | 11 | Markaz-09 | 1130.56d |
| 5 | 17CL-307 | 1168.06b | 12 | 17CL-306 | 1125.00de |
| 6 | 17CL-304 | 1165.28b | 13 | P Masoor-09 | 1102.78e |
| **CV=6.75** | | | | **LSD= 37.205** | |

The results indicated that the entry 17CL-308 exceeded all the genotypes by producing maximum yield (1234.72kg/ha) followed by entry 17CL-305 (1204.17kg/ha) while lowest yield was noted in entry P Masoor-09 (1102.78kg/ha).

**25. Lentil National Uniform Yield Trial 2019-20**

The trial was received from NARC, Islamabad comprising of 21 entries. The trial was sown on 30-10-2019 in a Randomized Complete Block Design with three replications. The plot size was kept 4.8 $m^2$ (1.2m x 4.0m) with row spacing of 30cm. The trial was harvested on 06-05-2020. Grain yield data were recorded and sent to quarter concerned as shown in Table 26.

**Table 26: Grain Yield of Lentil National Uniform Yield Trial 2019-20**

| Sr. No/ Ranking | Name/Code | Grain Yield (kg/ha) | Sr. No/ Ranking | Name/Code | Grain Yield (kg/ha) |
|---|---|---|---|---|---|
| 1 | J | 1113.89a | 12 | E | 1038.19cd |
| 2 | M | 1102.78a | 13 | Q | 1034.03d |
| 3 | I | 1086.11b | 14 | L | 1030.56d |
| 4 | C | 1078.47b | 15 | A | 1026.39d |
| 5 | H | 1070.14bc | 16 | U | 1020.83de |
| 6 | F | 1068.75bc | 17 | T | 1002.08e |
| 7 | B | 1065.28bc | 18 | R | 995.14e |
| 8 | K | 1061.11bc | 19 | P | 981.94f |
| 9 | G | 1054.86c | 20 | O | 975.69g |
| 10 | N | 1044.44cd | 21 | S | 969.44g |
| 11 | D | 1040.28cd | | | |
| **CV=6.47** | | | | **LSD=42.133** | |

The results indicated that the entry J exceeded all the genotypes by producing maximum yield (1113.89 kg/ha) followed by entry M (1102.78 kg/ha) while lowest yield was noted in entry S (969.44 kg/ha).

**(D) BRASSICA**

**26. National Uniform Yield Trial of Rapeseed 2019-20**

The trial was received from NARC, Islamabad comprising of 21 entries. The trial was sown on 23-10-2019 in a RCBD with three replications. The plot size was kept 4.8 $m^2$. The trial was harvested on 10-04-2020. Grain yield data were recorded and sent to quarter concerned as shown in Table 27.

**Table 27: Grain Yield of National Uniform Yield Trial of Rapeseed 2019-20**

| Sr. No. | Entry code / Name | Yield (kg/ha) | Sr. No. | Entry code / Name | Yield (kg/ha) |
|---|---|---|---|---|---|
| 1 | 06 | 802.08a | 12 | 21 | 618.06bcde |
| 2 | 16 | 774.31ab | 13 | 07 | 614.58bcde |
| 3 | 05 | 770.83ab | 14 | 14 | 611.11bcde |
| 4 | 10 | 750.00ab | 15 | 02 | 590.28cde |
| 5 | 13 | 739.58abc | 16 | 09 | 579.86cde |
| 6 | 08 | 722.22abc | 17 | 11 | 552.08cde |
| 7 | 20 | 718.75abc | 18 | 15 | 531.25cde |
| 8 | 18 | 704.86abc | 19 | 04 | 524.31def |
| 9 | 03 | 680.56bcd | 20 | 19 | 520.83def |
| 10 | 12 | 677.08bcd | 21 | 17 | 479.17ef |
| 11 | 01 | 625.00bcd | | | |
| **CV= 5.42** | | | **LSD=39.25** | | |

The results indicated that the entry no. 06 exceeded all the genotypes by producing maximum yield (802.08 kg/ha) followed by entry no. 16 (774.31kg/ha) while lowest yield was observed in entry no. 17 (479.17 kg/ha).

## 27. National Uniform Yield Trial of Mustard 2019-20

The trial was received from NARC, Islamabad comprising of 35 entries. The trial was sown on 23-10-2019 in a Randomized Complete Block Design with three replications. The plot size was kept 4.8 $m^2$. The trial was harvested on 10-04-2020. Grain yield data were recorded and sent to quarter concerned as shown in Table 28.

**Table 28: Grain Yield of National Uniform Yield Trial of Mustard 2019-20**

| Sr. No. | Entry code / Name | Yield (kg/ha) | Sr. No. | Entry code / Name | Yield (kg/ha) |
|---|---|---|---|---|---|
| 1 | 1 | 1364.58a | 19 | 9 | 843.75def |
| 2 | 21 | 1274.31ab | 20 | 20 | 815.97defg |
| 3 | 25 | 1190.97abc | 21 | 29 | 812.50defg |
| 4 | 5 | 1184.03abc | 22 | 23 | 809.03efg |
| 5 | 19 | 1131.94abc | 23 | 33 | 805.56efg |
| 6 | 34 | 1041.67bcd | 24 | 14 | 784.72efgh |

| | | | | | |
|---|---|---|---|---|---|
| 7 | 27 | 1003.47bcd | 25 | 10 | 770.83efgh |
| 8 | 2 | 975.69cde | 26 | 35 | 767.36efgh |
| 9 | 4 | 968.75cde | 27 | 3 | 760.42efgh |
| 10 | 24 | 937.50cde | 28 | 32 | 739.58efhg |
| 11 | 13 | 930.56cde | 29 | 30 | 736.11efgh |
| 12 | 22 | 923.61cde | 30 | 8 | 704.86fgh |
| 13 | 15 | 888.89def | 31 | 31 | 677.08fgh |
| 14 | 7 | 868.06def | 32 | 16 | 666.67fgh |
| 15 | 26 | 861.11def | 33 | 6 | 652.78fgh |
| 16 | 11 | 857.64def | 34 | 17 | 645.83fgh |
| 17 | 18 | 850.69def | 35 | 12 | 631.94fghi |
| 18 | 28 | 847.22def | | | |
| **CV=4.31** | | | **LSD=28.674** | | |

The results indicated that the entry no. 01 exceeded all the genotypes by producing maximum yield (1364.58 kg/ha) followed by entry no. 21 (1274.31kg/ha) while lowest yield was observed in entry no. 12 (631.94 kg/ha).

**28. National Uniform Yield Trial of Taramira 2019-20**

The trial was received from NARC, Islamabad comprising of 06 entries. The trial was sown on 23-10-2019 in a Randomized Complete Block Design with three replications. The plot size was kept 4.8 $m^2$ (1.2m x 4.0m) with row spacing of 30cm. The trial was harvested on 10-04-2020. Grain yield data were recorded and sent to quarter concerned as shown in Table 29.

**Table 29: Grain Yield of National Uniform Yield Trial of Taramira 2019-20**

| Sr. No. | Entry code / Name | Yield (kg/ha) | Sr. No. | Entry code / Name | Yield (kg/ha) |
|---|---|---|---|---|---|
| **1** | 3 | 791.67a | **4** | 1 | 663.19bcd |
| 2 | 5 | 767.36ab | 5 | 6 | 642.36bcd |
| 3 | 4 | 677.08abc | 6 | 2 | 593.75e |
| **CV=4.1** | | | **LSD=25.854** | | |

The results indicated that the entry no. 03 exceeded all the genotypes by producing maximum yield (791.67 kg/ha) followed by entry no. 05 (767.36 kg/ha) while lowest yield was observed in entry no. 02 (593.75 kg/ha).

### 29. Rapeseed Micro Yield Trial 2019-20

The trial was received from Oilseed Research Institute, Faisalabad, comprising of 11 entries. The trial was sown on 23-10-2019 in a RCBD with three replications. The plot size was kept 4.8 $m^2$. The trial was harvested on 13-04-2020. Grain yield data were recorded and sent to quarter concerned as shown in Table 30.

**Table 30: Grain Yield of Rapeseed Micro Yield Trial 2019-20**

| Sr. No. | Entry code / Name | Yield (kg/ha) | Sr. No. | Entry code / Name | Yield (kg/ha) |
|---|---|---|---|---|---|
| **1** | I | 1037.04a | 7 | A | 833.33bc |
| 2 | D | 1013.89a | 8 | E | 814.81bc |
| 3 | H | 995.37ab | 9 | B | 717.59cd |
| 4 | K | 902.78b | 10 | J | 671.30cd |
| 5 | C | 893.52bc | 11 | F | 634.26d |
| **6** | G | 856.48bc | | | |
| **CV=7.42** | | | | **LSD=42.68** | |

The results indicated that the entry I exceeded all the genotypes by producing maximum yield (1037.04 kg/ha) followed by entry D (1013.89 kg/ha) while lowest yield was observed in entry F (634.26 kg/ha).

### 30. Mustard Micro Yield Trial 2019-20

The trial was received from Oilseed Research Institute, Faisalabad comprising of 12 entries. The trial was sown on 23-10-2019 in a RCBD with three replications. The plot size was kept 4.8 $m^2$. The trial was harvested on 13-04-2020. Grain yield data were recorded and sent to quarter concerned as shown in Table 31.

**Table 31: Grain Yield of Mustard Micro Yield Trial 2019-20**

| Sr. No. | Entry code / Name | Yield (kg/ha) | Sr. No. | Entry code / Name | Yield (kg/ha) |
|---|---|---|---|---|---|
| **1** | 12 | 1092.59a | **7** | 7 | 796.30c |
| 2 | 9 | 1060.19a | 8 | 5 | 726.85c |

| | | | | | |
|---|---|---|---|---|---|
| 3 | 8 | 981.48b | 9 | 3 | 703.70c |
| 4 | 6 | 837.96bc | 10 | 2 | 671.30cd |
| 5 | 11 | 814.81bc | 11 | 1 | 615.74cd |
| 6 | 4 | 800.93bc | 12 | 10 | 587.96e |
| **CV=5.6** | | | **LSD=34.35** | | |

The results indicated that the entry no. 12 exceeded all the genotypes by producing maximum yield (1092.59 kg/ha) followed by entry no.09 (1060.19 kg/ha) while lowest yield was observed in entry no. 10 (587.96 kg/ha).

### 31. Biofortification of Zinc in Wheat Trial 2019-20

A study was conducted to evaluate the response of wheat varieties with respect to application of zinc sulphate. The trial was sown on 13-11-2019 in a RCBD with three replications. The plot size was kept 4.8 $m^2$. The trial was harvested on 15-05-2020. Grain yield data were recorded as under (Table 32):

**Table 32: Grain Yield of Mustard Micro Yield Trial 2019-20**

| Zinc Application | Grain Yield (kg/ha) | | Mean |
|---|---|---|---|
| | FJ-16 | 15FJ05 | |
| **Control** | 2667.50 | 2340.00 | 2503.75 |
| **Seed Priming** | 2607.50 | 2322.50 | 2465 |
| **Soil Application** | 2475.00 | 2315.00 | 2395 |
| **Mean** | 2583.33 | 2325.83 | |
| LSD (0.05) Treatment= 112.69<br>LSD (0.05) Genotype = 92.58<br>LSD (0.05) Genotype x Treatment = 162.14<br>CV% = 3.42 | | | |

The results indicated that the genotype 15FJ05 gave highest yield under soil application (7583.33 kg/ha) of zinc as compared to seed priming (7201.39 kg/ha)

### Groundnut Research Station, Attock

### OVERVIEW

The groundnut crop has the strategic importance for the inhabitants of the dry land region. About 84% of groundnut area and production is contributed by Pothohar, especially Rawalpindi Division, with the area of 190,000 acres (91% of Punjab) and

production of around 74000 tons. Attock produces around 15000 tons of groundnut from an area of around 50,000 acres. Groundnut is an excellent source of edible oil as it contains about 46-55% high quality oil and 23-28% protein. Moreover, it is the only heat loving crop for the region grown under rainfed conditions and gives the highest economic returns as compared to the other agricultural crops. The produce is estimated to contribute 12.500 billion PKR to the national economy. Groundnut harvesting and threshing are labor intensive activities which generate a lot of employment opportunities for the rural population and provide job to around 1.52 million rural poor people. Its role in the country's nutritional security, poverty alleviation and employment generation programs is becoming increasingly important. Attock has soothing climatic conditions with unique agro-ecology, low to medium rainfall areas and sandy loam soil which is ideal for growing Groundnut and Gram crops. Geographical facts and soothing climatic indicators are presented as under.

**Objectives**

- Strengthening of gene pool of diverse origin
- Development of high yielding and short season varieties
- Standardization of production technologies
- Production of good quality seed.

**(A) KHARIF 2019**

**1. Maintenance of Groundnut Germplasm.**

Groundnut germplasm comprising of 70 varieties/advance lines were sown on 01-04-2019 having a plot size of 3.6 $m^2$ to maintain their seed. Recommended crop management practices were adopted. Data on different agronomic characteristics were recorded. Some entries were used for making fresh crosses. At maturity, the seed of all the lines/varieties was collected, dried, threshed, cleaned and stored properly. Traits variability range observed in the germplasm is as under (Table 1):

**Table 1: Traits diversity present in the germplasm**

| Sr. No. | Character Studied | Minimum | Maximum |
|---|---|---|---|
| 1 | Days to flower initiation | 29 | 48 |
| 2 | Days to flowering (50%) | 43 | 81 |
| 3 | Plant height (cm) | 12 | 62 |
| 4 | No. of Branches/plant | 3 | 8 |
| 5 | No. of Pods/plant | 50 | 145 |

| | | | |
|---|---|---|---|
| 6 | Shelling percentage | 55 | 78 |
| 7 | 100 grain weight (g) | 39 | 80 |
| 8 | Dry Pod yield (kg/ha) | 1170 | 3560 |

**2. Crossing Block.**

Thirteen crosses were performed among selected genotypes to induce genetic variability, increase seed yield potential and disease resistance into groundnut crop. Recommended crop management practices were adopted for healthy crop stand. At maturity, eight successful crosses were harvested for their evaluation in filial generations.

**2. Study of Filial Generations.**

To evaluate and select desirable recombinants, early (F1 – F3) and advance (F4 – F7) generations were evaluated on the basis of number of pods per plant, number of seed per pod, pod yield per plant and disease resistance in the field (table2).

**Table 2: Breeding Generations From $F_0$ to $F_6$ in Kharif 2019**

| Filial Generation | Entries studied | Entries Selected |
|---|---|---|
| **Fresh Crosses** | 12 attempted | 08 successful |
| **F1** | 09 crosses | 08 crosses |
| **F2** | 03 crosses (16 Progenies) | 03 crosses (29 SPS) |
| **F4** | 04 crosses (28 Progenies) | 04 crosses (40SPS) |
| **F6** | 03 crosses (24 Progenies) | 03 rosses (24SPS) |

**i. Early Generations (F1 – F2)**

**a) $F_1$ Generation**

Nine crosses were studied. At maturity, the seed of eight crosses was collected for further evaluation on the basis of number of pods per plant, number of seed per pod, pod yield per plant and disease resistance in F2 generation.

**b) $F_2$ Generation**

$F_2$ populations of 3 crosses (16 progenies) were sown in the field. Recommended crop management practices were adopted. Maximum

segregation was observed in the population. Segregating populations of groundnut were evaluated against varioue parameters and 29 SPS were selected.

**c) Advance Generations ($F_4$ and $F_6$)**

In $F_4$ generation, 28 plants/progenies was sown in single row progeny lines with 20 cm plant spacing. Recommended crop management practices were adopted for healthy crop stand. Field observations were recorded for desirable traits. At maturity, 40 single plant selections were made for further studies in subsequent filial generation.

Similarly in $F_6$ 24 plants/progenies were studied and Single plants were selected on field performance basis and all of the 24 SPS were selected for further advancement.

**3. Yield Trials.**

**i. Trial – A**

An experiment was conducted to evaluate yield performance of six entries with two check varieties (BARI-2016 and BARI 2011). The experiment was sown on 04-04-2019 at the Station in Randomized Complete Block Design with three replications having plot size of 3.6$m^2$. The experiment was harvested on 08-11-2019 (Table3)

**Table 3: Pod Yield in Trail-A**

| Sr. No. | Entry Name | Pod Yield (Kg/ha) |
|---|---|---|
| 1 | 18AK011 | 3912 |
| 2 | 18AK009 | 3870 |
| 3 | BARI-2016 | 4005 |
| 4 | 18AK010 | 3917 |
| 5 | 18AK007 | 4046 |
| 6 | 18AK008 | 2866 |
| 7 | BARI-2011 | 3685 |
| 8 | 18AK012 | 3981 |
| LSD (0.05) = 293.3 | CV% = 9.72 | |

The advance line18AK007 produced maximum pod yield (4046 kg $ha^{-1}$), followed by entry BARI-2016 (4004 kg $ha^{-1}$). The lowest pod yield was found in 18AK008 (2866

kg $ha^{-1}$). The entries 18AK012, 18AK010, 18AK011 and 18AK009 were non-significant with check variety BARI-2016 and significantly higher than BARI-2011.

**ii. Trial – B**

An experiment was conducted to evaluate yield performance of four entries with two check varieties (BARI-2016 and BARI 2011). The experiment was sown on 04-04-2019 at the Station in Randomized Complete Block Design with three replications having plot size of 3.6$m^2$. The experiment was harvested on 08-11-2019. Pod yield data is given as under (Table 4):

**Table 4: Pod Yield in Trail-B**

| Sr. No. | Entry Name | Pod Yield (Kg/ha) |
|---|---|---|
| 1 | 18AK002 | 4144 |
| 2 | 18AK001 | 2972 |
| 3 | 18AK004 | 2519 |
| 4 | BARI-2011 | 2403 |
| 5 | 18AK006 | 2338 |
| 6 | BARI-2016 | 2241 |
| LSD (0.05) = 205.3 | | CV% = 5.95 |

The advance line18AK002 produced maximum pod yield (4144 kg $ha^{-1}$), followed by entry 18AK001 (2972kg $ha^{-1}$). The lowest pod yield was found in BARI-2016 (2241 kg $ha^{-1}$).

**5.Micro Yield Trial.**

A combined experiment was conducted to evaluate yield performance of five entries of this research station and thirteen from BARI, Chakwal against two check varieties (BARI-2016, BARI-2011). The trial was sown at BARI, Chakwal and GRS, Attock. The experiment was sown on 03-04-2019 at Groundnut Research Station, Attock in Randomized Complete Block Design with three replications having plot size of 3.6$m^2$. The experiment was harvested on 31-10-2019. Analyzed data of pod yield is presented as under (Table 5).

**Table 5: Pod Yield in Trail-A**

| Sr. No. | Entry Name | Mean Pod Yield (Kg/ha) | Sr. No. | Entry Name | Mean Pod Yield (Kg/ha) |
|---|---|---|---|---|---|
| 1 | 17AK001 | 5042 | 11 | 16CG006 | 4838 |
| 2 | 17AK002 | 5509 | 12 | 16CG007 | 3579 |
| 3 | 17AK003 | 4308 | 13 | 16CG008 | 2759 |
| 4 | 17AK004 | 4731 | 14 | 17CG001 | 3074 |
| 5 | 17AK005 | 5032 | 15 | 17CG002 | 5782 |
| 6 | 16CG001 | 4741 | 16 | 17CG003 | 4889 |
| 7 | 16CG002 | 5231 | 17 | 17CG004 | 5824 |
| 8 | 16CG003 | 3014 | 18 | 17CG005 | 5491 |
| 9 | 16CG004 | 4806 | 19 | BARI-11 | 4759 |
| 10 | 16CG005 | 5366 | 20 | BARI-16 | 4060 |
| LSD (0.05) = 360.2 | | | CV% = 13.04 | | |

Advance line 17CG004 (5824 kg $ha^{-1}$) produced significantly higher pod yield than others. The lowest pod yield was found in 16CG008 (2759 kg $ha^{-1}$).

**6.National Uniform Groundnut Yield Trial 2019.**

The trial was received from National Coordinator, Oilseed crops, PARC Islamabad in coded form, to determine the comparative yield performance of ten entries at Groundnut Research Station, Attock. The experiment was sown on 15-04-2019 in Randomize Complete Block Design with three replications having plot size of 7.2 $m^2$. The trial was harvested on 13-11-2019. The yield data is given as under(Table 6):

**Table 6: Pod Yield in NGYT 2019**

| Entries | RI (g/plot) | RII (g/plot) | RIII (g/plot) | Mean (g/plot) | Yield (Kg/ha) |
|---|---|---|---|---|---|
| 1 | 2880 | 1960 | 3820 | 2887 | 4009 |
| 2 | 3335 | 3175 | 3675 | 3395 | 4715 |
| 3 | 3145 | 3470 | 3495 | 3370 | 4681 |
| 4 | 3125 | 2740 | 2395 | 2753 | 3824 |

| | | | | | |
|---|---|---|---|---|---|
| 5 | 4105 | 3860 | 4085 | 4017 | 5579 |
| 6 | 3870 | 3055 | 2740 | 3222 | 4475 |
| 7 | 4195 | 3310 | 4075 | 3860 | 5361 |
| 8 | 2390 | 2125 | 2495 | 2337 | 3245 |
| 9 | 2325 | 1895 | 3455 | 2558 | 3553 |
| 10 | 3215 | 3605 | 3335 | 3385 | 4701 |
| LSD (0.05) = 785.98 | | | CV% = 14.42 | | |

Entry No. “5” produced higher pod yield of 5579 kg $ha^{-1}$ followed by Entry No. “7” (5361 kg $ha^{-1}$). While entry No. “8” produced the lowest pod yield (3245 kg $ha^{-1}$).

**7.Evaluation of Groundnut Candidate Line 11AK011 At the Farmer’s Field**

The trial was conducted to evaluate newly evolved candidate groundnut line 11AK011 at farmer’s field along with check variety BARI-2011. The trial was sown at three different locations viz: Attock, Jand and Pindi Ghaib at 4 kanals of each genotype. The yield data is given as under (Table 7):

**Table 7: Pod Yield of Groundnut Candidate Line 11AK011 At The Farmer’s Field**

| Genotype | Dry Pod Yield (Kg/ha) | | | Mean (Kg/ha) |
|---|---|---|---|---|
| | Attock | Jand | Pindi Ghaib | |
| 11AK011 | 3235 | 3190 | 3035 | 3153 |
| BARI-2011 | 2735 | 2415 | 2541 | 2564 |

The results showed that 11AK011 proved better than BARI-2011 at all locations with mean dry pod yield of 3153 Kg/ha.

**8.Sowing Date Studies of Groundnut Candidate Genotype**

The experiment was laid out to determine the comparative yield performance and best sowing date in groundnut advance line (11AK011) as compared to check variety BARI-2011 under rainfed conditions at Groundnut Research Station, Attock. The experiment was sown on four different sowing dates i.e., 20-03-2019, 30-03-2019, 10-

04-2019 and 20-04-2019 in factorial (RCBD) with three replications having plot size of 7.2m$^2$. The trial was harvested on 11-11-2019. The yield data is given as under (Table 8):

**Table 8: Pod Yield of Sowing Date Studies of Groundnut Candidate Line 11AK011**

| Sowing Dates | Pod Yield (Kg/ha) | | Mean |
|---|---|---|---|
| | BARI-2011 | 11AK011 | |
| **20-03-2019** | 2153 | 2428 | 2291 |
| **30-03-2019** | 2694 | 2894 | 2794 |
| **10-04-2019** | 3139 | 3364 | 3252 |
| **20-04-2019** | 2586 | 2411 | 2499 |
| **Mean** | 2643 | 2774 | |
| LSD (0.05) Sowing Date = 176.2<br>LSD (0.05) Genotype = 152.7<br>LSD (0.05) Genotype x Sowing date = 327.2, CV% = 8.21 | | | |

The results showed that groundnut advance line 11AK011 produced higher pod yield on 10-04-2019 (3364 kg ha$^{-1}$) as compared to other check varieties and other sowing dates.

**9.Sowing rate Studies of Groundnut Candidate Genotype**

The experiment was laid out to determine the comparative yield performance and best seed rate in groundnut advance line (11AK011) as compared to check variety BARI-2011 under rainfed conditions at Groundnut Research Station, Attock. The experiment was sown on 15-04-2019 in factorial (RCBD) having four dry pod seed rates (125kg/ha, 150kg/ha, 175kg/ha, 200kg/ha) with three replications having plot size of 7.2m$^2$. The trial was harvested on 12-11-2019. The yield data is given as under (Table 9):

**Table 9: Pod Yield of Sowing Rate Studies of Groundnut Candidate Line 11AK011**

| Seed Rates | Pod Yield (Kg/ha) | | Mean |
|---|---|---|---|
| | BARI-2011 | 11AK011 | |
| **125 kg/ha** | 2444 | 3130 | 2787 |

| | | | |
|---|---|---|---|
| **150 kg/ha** | 4245 | 4009 | 4127 |
| **175 kg/ha** | 3384 | 4292 | 3838 |
| **200 kg/ha** | 4009 | 2560 | 3285 |
| **Mean** | 3521 | 3498 | |
| LSD (0.05) Seed Rates = 736.57<br>LSD (0.05) Genotype = 257.95<br>LSD (0.05) Genotype x Seed Rates = 929.77<br>CV% = 11.69 | | | |

The results showed that groundnut advance line 11AK011 produced higher pod yield with seed rate of 175 kg/ha dry pods (4292 kg $ha^{-1}$) as compared to other check varieties and other seed rates.

**10.Fertilizer rate Studies of Groundnut Candidate Genotype**

The experiment was laid out to determine the comparative yield performance as effected by different fertilizer doses in groundnut advance line (11AK011) as compared to BARI 2011 under rainfed conditions at Groundnut Research Station, Attock. The experiment was sown on 15-04-2019 in factorial (RCBD) having nine different N:P:K doses in kg/ha with three replications having plot size of 7.2$m^2$. The trial was harvested on 18-10-2019. The yield data is given as under (Table 10):

**Table 10: Pod Yield of Sowing Rate Studies of Groundnut Candidate Line 11AK011**

| **Fertilizer Rate NPK (Kg/ha)** | **Pod Yield (Kg/ha)** | | **Mean (Kg/ha)** |
|---|---|---|---|
| | **BARI-2011** | **11AK011** | |
| **0:0:0** | 2407 | 2347 | 2377 |
| **10:80:30** | 3360 | 3023 | 3192 |
| **20:80:30** | 3157 | 3574 | 3366 |
| **30:80:30** | 4032 | 4694 | 4363 |
| **20:0:30** | 3454 | 3329 | 3392 |
| **20:40:30** | 3273 | 3583 | 3428 |
| **20:120:30** | 3421 | 3458 | 3440 |
| **20:80:0** | 2852 | 2528 | 2690 |
| **20:80:10** | 3148 | 2727 | 2938 |

| | | | |
|---|---|---|---|
| **20:80:30** | 2694 | 2884 | 2789 |
| **Mean** | 3180 | 3215 | |
| LSD (0.05) Fertilizer Rate =297.89<br>LSD (0.05) Genotype = 286.21<br>LSD (0.05) Genotype x Fertilizer rate = 470.2<br>CV% = 7.96 | | | |

The above results showed that groundnut advance line 11AK011 with fertilizer dose of 30:80:30 NPK kg/ha produced higher pod yield (4694 kg $ha^{-1}$) as compared to other check varieties and other fertilizer doses.

**11.Response of Groundnut Advance lines to hydrogel Application.**

The experiment was laid out to determine the comparative yield performance as affected by different hydrogel doses to coupe moisture stress to groundnut varieties to BARI 2011, BARI-2016 under rainfed conditions at Groundnut Research Station, Attock. The experiment was sown on 29-04-2019 in factorial (RCBD) having four different hydrogel doses in kg/ha with three replications having plot size of 7.2$m^2$. The trial was harvested on 12-11-2019. The yield data is given as under (Table11):

**Table 11: Response of Groundnut Candidate Lines to hydrogel Application**

| **Hydrogel Rates** | **Pod Yield (Kg/ha)** | | **Mean** |
|---|---|---|---|
| | **BARI-2016** | **BARI-2011** | |
| **0 kg/ha** | 2509 | 2023 | 2266 |
| **20 kg/ha** | 3264 | 3000 | 3132 |
| **25 kg/ha** | 4102 | 3755 | 3929 |
| **30 kg/ha** | 3819 | 2630 | 3225 |
| **Mean** | 3424 | 2852 | |
| LSD (0.05) Hydrogel Rates = 399.64<br>LSD (0.05) Genotype = 933.8<br>LSD (0.05) Genotype x Hydrogel Rates = 1000.8<br>CV% = 10.12 | | | |

The results showed that groundnut varieties showed maximum pod yield with hydrogel rate of 25 kg/ha dry pods (3929 kg $ha^{-1}$).

**12.Mash Micro Yield Trial (BARI)**

The above trial seed along with sowing plan was received from Director, BARI, Chakwal. The trial was sown on 18-07-2019 in RCBD with three replications. The plot size was 5.4 $m^2$. The trial was harvested on 12-10-2019. The grain yield data is as under Table12):

**Table 12: Grain Yield of MYT 2019**

| ENTRY | Grain Yield (g/plot) | | | | Grain Yield (kg/ha) |
|---|---|---|---|---|---|
| | R I | R II | RIII | Mean | |
| 16CM-701 | 285 | 255 | 235 | 258.33 | 478.40 |
| 16CM-702 | 215 | 190 | 230 | 211.67 | 391.98 |
| 16CM-703 | 185 | 205 | 190 | 193.33 | 358.02 |
| 16CM-704 | 245 | 200 | 240 | 228.33 | 422.84 |
| 16CM-705 | 180 | 210 | 195 | 195.00 | 361.11 |
| 16CM-706 | 270 | 255 | 230 | 251.67 | 466.05 |
| 16CM-707 | 290 | 215 | 230 | 245.00 | 453.70 |
| 16CM-708 | 265 | 280 | 240 | 261.67 | 484.57 |
| 16CM-709 | 190 | 260 | 265 | 238.33 | 441.36 |
| 16CM-710 | 245 | 235 | 200 | 226.67 | 419.75 |
| Ch- Mash | 235 | 245 | 265 | 248.33 | 459.88 |
| Arooj | 250 | 270 | 245 | 255.00 | 472.22 |

The results showed that advance line 16CM-708 exceeded all the lines and checks (484.57 kg $ha^{-1}$). While the lowest yield was produced by 16CM-703 (358.02 kg $ha^{-1}$).

**(B) RABI 2019-20.**

**1.National Uniform Wheat Yield Trial 2019-20**

The trial was received from Coordinator Wheat, PARC Islamabad, comprised of 60 promising lines which was sown on 11-11-2019 entries in coded form. The trial aimed to evaluate for yield, drought and disease resistance in advance lines of wheat belonging to different research institutes and stations of Pakistan under local

environmental conditions. The trial was harvested on 29-04-2020. The yield data (Table 13) was send to quarter concerned. The yield ranged from 1266-7000 Kg/ha in different entries and plot.

**Table 13: Grain Yield in NUWYT 2019-20**

| Plot No. | Rep | Sub Block | G. yield (g/plot) | G. Yield (Kg/ha) | Plot No. | Rep | Sub Block | G. yield (g/plot) | G. Yield (Kg/ha) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 4535 | 5038.89 | 61 | 2 | 1 | 3470 | 3855.56 |
| 2 | 1 | 1 | 6190 | 6877.78 | 62 | 2 | 1 | 5110 | 5677.78 |
| 3 | 1 | 1 | 4330 | 4811.11 | 63 | 2 | 1 | 3725 | 4138.89 |
| 4 | 1 | 1 | 3710 | 4122.22 | 64 | 2 | 1 | 4565 | 5072.22 |
| 5 | 1 | 1 | 4985 | 5538.89 | 65 | 2 | 1 | 3925 | 4361.11 |
| 6 | 1 | 1 | 4580 | 5088.89 | 66 | 2 | 1 | 2530 | 2811.11 |
| 7 | 1 | 1 | 4080 | 4533.33 | 67 | 2 | 1 | 4315 | 4794.44 |
| 8 | 1 | 1 | 4335 | 4816.67 | 68 | 2 | 1 | 5055 | 5616.67 |
| 9 | 1 | 1 | 5280 | 5866.67 | 69 | 2 | 1 | 4190 | 4655.56 |
| 10 | 1 | 1 | 3060 | 3400.00 | 70 | 2 | 1 | 5180 | 5755.56 |
| 11 | 1 | 2 | 4640 | 5155.56 | 71 | 2 | 2 | 2690 | 2988.89 |
| 12 | 1 | 2 | 3395 | 3772.22 | 72 | 2 | 2 | 4525 | 5027.78 |
| 13 | 1 | 2 | 4910 | 5455.56 | 73 | 2 | 2 | 4405 | 4894.44 |
| 14 | 1 | 2 | 4340 | 4822.22 | 74 | 2 | 2 | 4690 | 5211.11 |
| 15 | 1 | 2 | 4475 | 4972.22 | 75 | 2 | 2 | 4785 | 5316.67 |
| 16 | 1 | 2 | 3985 | 4427.78 | 76 | 2 | 2 | 5200 | 5777.78 |
| 17 | 1 | 2 | 2895 | 3216.67 | 77 | 2 | 2 | 3680 | 4088.89 |
| 18 | 1 | 2 | 3825 | 4250.00 | 78 | 2 | 2 | 3315 | 3683.33 |
| 19 | 1 | 2 | 3375 | 3750.00 | 79 | 2 | 2 | 4165 | 4627.78 |
| 20 | 1 | 2 | 3705 | 4116.67 | 80 | 2 | 2 | 2646 | 2940.00 |
| 21 | 1 | 3 | 2255 | 2505.56 | 81 | 2 | 3 | 3385 | 3761.11 |
| 22 | 1 | 3 | 2940 | 3266.67 | 82 | 2 | 3 | 4535 | 5038.89 |
| 23 | 1 | 3 | 4180 | 4644.44 | 83 | 2 | 3 | 3810 | 4233.33 |
| 24 | 1 | 3 | 3850 | 4277.78 | 84 | 2 | 3 | 4480 | 4977.78 |
| 25 | 1 | 3 | 3985 | 4427.78 | 85 | 2 | 3 | 3820 | 4244.44 |
| 26 | 1 | 3 | 4605 | 5116.67 | 86 | 2 | 3 | 4850 | 5388.89 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 27 | 1 | 3 | 3990 | 4433.33 | 87 | 2 | 3 | 4055 | 4505.56 |
| 28 | 1 | 3 | 4805 | 5338.89 | 88 | 2 | 3 | 5005 | 5561.11 |
| 29 | 1 | 3 | 3375 | 3750.00 | 89 | 2 | 3 | 4435 | 4927.78 |
| 30 | 1 | 3 | 3110 | 3455.56 | 90 | 2 | 3 | 3065 | 3405.56 |
| 31 | 1 | 4 | 5280 | 5866.67 | 91 | 2 | 4 | 4739 | 5265.56 |
| 32 | 1 | 4 | 2780 | 3088.89 | 92 | 2 | 4 | 3945 | 4383.33 |
| 33 | 1 | 4 | 2695 | 2994.44 | 93 | 2 | 4 | 4600 | 5111.11 |
| 34 | 1 | 4 | 3275 | 3638.89 | 94 | 2 | 4 | 4320 | 4800.00 |
| 35 | 1 | 4 | 4135 | 4594.44 | 95 | 2 | 4 | 1475 | 1638.89 |
| 36 | 1 | 4 | 3990 | 4433.33 | 96 | 2 | 4 | 3755 | 4172.22 |
| 37 | 1 | 4 | 4145 | 4605.56 | 97 | 2 | 4 | 3810 | 4233.33 |
| 38 | 1 | 4 | 1140 | 1266.67 | 98 | 2 | 4 | 2880 | 3200.00 |
| 39 | 1 | 4 | 3875 | 4305.56 | 99 | 2 | 4 | 4455 | 4950.00 |
| 40 | 1 | 4 | 3010 | 3344.44 | 100 | 2 | 4 | 4010 | 4455.56 |
| 41 | 1 | 5 | 3405 | 3783.33 | 101 | 2 | 5 | 4830 | 5366.67 |
| 42 | 1 | 5 | 3190 | 3544.44 | 102 | 2 | 5 | 3765 | 4183.33 |
| 43 | 1 | 5 | 4230 | 4700.00 | 103 | 2 | 5 | 3740 | 4155.56 |
| 44 | 1 | 5 | 5085 | 5650.00 | 104 | 2 | 5 | 2875 | 3194.44 |
| 45 | 1 | 5 | 5290 | 5877.78 | 105 | 2 | 5 | 4870 | 5411.11 |
| 46 | 1 | 5 | 2635 | 2927.78 | 106 | 2 | 5 | 4683 | 5203.33 |
| 47 | 1 | 5 | 5455 | 6061.11 | 107 | 2 | 5 | 4935 | 5483.33 |
| 48 | 1 | 5 | 3605 | 4005.56 | 108 | 2 | 5 | 5190 | 5766.67 |
| 49 | 1 | 5 | 3960 | 4400.00 | 109 | 2 | 5 | 6300 | 7000.00 |
| 50 | 1 | 5 | 3470 | 3855.56 | 110 | 2 | 5 | 4175 | 4638.89 |
| 51 | 1 | 6 | 5675 | 6305.56 | 111 | 2 | 6 | 3925 | 4361.11 |
| 52 | 1 | 6 | 5475 | 6083.33 | 112 | 2 | 6 | 4790 | 5322.22 |
| 53 | 1 | 6 | 3565 | 3961.11 | 113 | 2 | 6 | 2640 | 2933.33 |
| 54 | 1 | 6 | 4220 | 4688.89 | 114 | 2 | 6 | 4098 | 4553.33 |
| 55 | 1 | 6 | 5165 | 5738.89 | 115 | 2 | 6 | 3660 | 4066.67 |
| 56 | 1 | 6 | 3140 | 3488.89 | 116 | 2 | 6 | 2750 | 3055.56 |
| 57 | 1 | 6 | 3310 | 3677.78 | 117 | 2 | 6 | 3240 | 3600.00 |
| 58 | 1 | 6 | 6015 | 6683.33 | 118 | 2 | 6 | 4785 | 5316.67 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59 | 1 | 6 | 5810 | 6455.56 | 119 | 2 | 6 | 5580 | 6200.00 |
| 60 | 1 | 6 | 5320 | 5911.11 | 120 | 2 | 6 | 3835 | 4261.11 |

The data in the above table indicated that the Plot No. 109 exceeded all the entries in the trial by producing highest grain yield (7000.00 kg/ha) followed by the genotypes No. 2 (7877.78 kg/ha) while the lowest yield was produced was genotype No. 38 (1266.67 kg/ha).

**2.PUNJAB UNIFORM WHEAT YIELD TRIAL 2019-20**

The trial was received from Director Wheat Research Institute, Faisalabad comprising of 50 advance lines of wheat from different research institutes and stations of Punjab. The trials were sown on 11-11-2019 in Alpha Lattice Design with two replications. Each entry was sown in a plot size of 4.5 $m^2$ (0.9m x 5m), with row spacing of 22.5cm. The trial was harvested on 28-04-2020. The yield data was recorded (Table 14) and sent to quarter concerned.

**Table 14: Grain Yield in PUWYT 2019-20**

| Plot No. | V. Code | Rep | Sub Block | G. yield (g/plot) | G. Yield (Kg/ha) | Plot No. | V. Code | Rep | Sub Block | G. yield (m/plot) | G. Yield (Kg/ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 2640 | 4400.00 | 51 | 38 | 2 | 1 | 510 | 850.00 |
| 2 | 2 | 1 | 1 | 3365 | 5608.33 | 52 | 44 | 2 | 1 | 2275 | 3791.67 |
| 3 | 3 | 1 | 1 | 2870 | 4783.33 | 53 | 10 | 2 | 1 | 3115 | 5191.67 |
| 4 | 4 | 1 | 1 | 1835 | 3058.33 | 54 | 32 | 2 | 1 | 1335 | 2225.00 |
| 5 | 5 | 1 | 1 | 2980 | 4966.67 | 55 | 46 | 2 | 1 | 3225 | 5375.00 |
| 6 | 6 | 1 | 2 | 3005 | 5008.33 | 56 | 4 | 2 | 2 | 2210 | 3683.33 |
| 7 | 7 | 1 | 2 | 2490 | 4150.00 | 57 | 29 | 2 | 2 | 2475 | 4125.00 |
| 8 | 8 | 1 | 2 | 715 | 1191.67 | 58 | 19 | 2 | 2 | 2870 | 4783.33 |
| 9 | 9 | 1 | 2 | 2995 | 4991.67 | 59 | 31 | 2 | 2 | 3290 | 5483.33 |
| 10 | 10 | 1 | 2 | 3075 | 5125.00 | 60 | 47 | 2 | 2 | 2400 | 4000.00 |
| 11 | 11 | 1 | 3 | 2485 | 4141.67 | 61 | 17 | 2 | 3 | 2445 | 4075.00 |
| 12 | 12 | 1 | 3 | 2650 | 4416.67 | 62 | 41 | 2 | 3 | 3055 | 5091.67 |
| 13 | 13 | 1 | 3 | 2460 | 4100.00 | 63 | 37 | 2 | 3 | 2940 | 4900.00 |
| 14 | 14 | 1 | 3 | 3285 | 5475.00 | 64 | 27 | 2 | 3 | 1895 | 3158.33 |
| 15 | 15 | 1 | 3 | 2425 | 4041.67 | 65 | 25 | 2 | 3 | 2630 | 4383.33 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 16 | 1 | 4 | 2620 | 4366.67 | 66 | 50 | 2 | 4 | 2665 | 4441.67 |
| 17 | 17 | 1 | 4 | 2410 | 4016.67 | 67 | 14 | 2 | 4 | 3435 | 5725.00 |
| 18 | 18 | 1 | 4 | 3300 | 5500.00 | 68 | 43 | 2 | 4 | 2685 | 4475.00 |
| 19 | 19 | 1 | 4 | 3470 | 5783.33 | 69 | 33 | 2 | 4 | 4065 | 6775.00 |
| 20 | 20 | 1 | 4 | 2840 | 4733.33 | 70 | 16 | 2 | 4 | 2945 | 4908.33 |
| 21 | 21 | 1 | 5 | 2465 | 4108.33 | 71 | 5 | 2 | 5 | 2510 | 4183.33 |
| 22 | 22 | 1 | 5 | 2720 | 4533.33 | 72 | 13 | 2 | 5 | 1945 | 3241.67 |
| 23 | 23 | 1 | 5 | 2050 | 3416.67 | 73 | 49 | 2 | 5 | 1940 | 3233.33 |
| 24 | 24 | 1 | 5 | 2040 | 3400.00 | 74 | 40 | 2 | 5 | 1670 | 2783.33 |
| 25 | 25 | 1 | 5 | 2635 | 4391.67 | 75 | 24 | 2 | 5 | 1800 | 3000.00 |
| 26 | 26 | 1 | 6 | 1675 | 2791.67 | 76 | 2 | 2 | 6 | 2965 | 4941.67 |
| 27 | 27 | 1 | 6 | 1355 | 2258.33 | 77 | 18 | 2 | 6 | 3105 | 5175.00 |
| 28 | 28 | 1 | 6 | 2220 | 3700.00 | 78 | 36 | 2 | 6 | 2065 | 3441.67 |
| 29 | 29 | 1 | 6 | 1625 | 2708.33 | 79 | 8 | 2 | 6 | 940 | 1566.67 |
| 30 | 30 | 1 | 6 | 1735 | 2891.67 | 80 | 12 | 2 | 6 | 2570 | 4283.33 |
| 31 | 31 | 1 | 7 | 2685 | 4475.00 | 81 | 48 | 2 | 7 | 2670 | 4450.00 |
| 32 | 32 | 1 | 7 | 660 | 1100.00 | 82 | 20 | 2 | 7 | 2640 | 4400.00 |
| 33 | 33 | 1 | 7 | 3270 | 5450.00 | 83 | 9 | 2 | 7 | 3110 | 5183.33 |
| 34 | 34 | 1 | 7 | 1895 | 3158.33 | 84 | 28 | 2 | 7 | 2940 | 4900.00 |
| 35 | 35 | 1 | 7 | 1840 | 3066.67 | 85 | 22 | 2 | 7 | 3125 | 5208.33 |
| 36 | 36 | 1 | 8 | 1455 | 2425.00 | 86 | 23 | 2 | 8 | 2290 | 3816.67 |
| 37 | 37 | 1 | 8 | 3315 | 5525.00 | 87 | 26 | 2 | 8 | 2060 | 3433.33 |
| 38 | 38 | 1 | 8 | 780 | 1300.00 | 88 | 39 | 2 | 8 | 3015 | 5025.00 |
| 39 | 39 | 1 | 8 | 2190 | 3650.00 | 89 | 35 | 2 | 8 | 2690 | 4483.33 |
| 40 | 40 | 1 | 8 | 1720 | 2866.67 | 90 | 15 | 2 | 8 | 3180 | 5300.00 |
| 41 | 41 | 1 | 9 | 2340 | 3900.00 | 91 | 7 | 2 | 9 | 3365 | 5608.33 |
| 42 | 42 | 1 | 9 | 2345 | 3908.33 | 92 | 34 | 2 | 9 | 2685 | 4475.00 |
| 43 | 43 | 1 | 9 | 2525 | 4208.33 | 93 | 45 | 2 | 9 | 3075 | 5125.00 |
| 44 | 44 | 1 | 9 | 2355 | 3925.00 | 94 | 21 | 2 | 9 | 2845 | 4741.67 |
| 45 | 45 | 1 | 9 | 1700 | 2833.33 | 95 | 1 | 2 | 9 | 2715 | 4525.00 |
| 46 | 46 | 1 | 10 | 3060 | 5100.00 | 96 | 6 | 2 | 10 | 3685 | 6141.67 |
| 47 | 47 | 1 | 10 | 1875 | 3125.00 | 97 | 11 | 2 | 10 | 2280 | 3800.00 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 48 | 48 | 1 | 10 | 2270 | 3783.33 | 98 | 42 | 2 | 10 | 2830 | 4716.67 |
| 49 | 49 | 1 | 10 | 2205 | 3675.00 | 99 | 30 | 2 | 10 | 2300 | 3833.33 |
| 50 | 50 | 1 | 10 | 2875 | 4791.67 | 100 | 3 | 2 | 10 | 2715 | 4525.00 |

The data in the above table indicated that the genotype in Plot No. 69 exceeded all the entries in the trial by producing highest grain yield (6775.00 kg/ha) followed by the genotypes in Plot No. 96 (6141.67 kg/ha) while the lowest yield was produced was genotype in Plot No. 51 (850.00 kg/ha).

### 3.LENTIL MICRO YIELD TRIAL 2019-20

Lentil Micro Yield trial was received Director, BARI, Chakwal. The trial consists of 12 entries including three check varieties. The trial was sown on 22-10-2019 and harvested on 202-04-2020. The yield data was recorded (Table 15) and compiled and send to quarter concerned.

**Table 15: Grain Yield in LMYT 2019-20**

| Sr. No. | Entry | Grain Yield (g/plot) | | | | Grain Yield (Kg/ha) |
|---|---|---|---|---|---|---|
| | | RI | RII | RIII | Mean | |
| 1 | 17CL301 | 1150 | 995 | 1025 | 1056.7 | 1956.8 |
| 2 | 17CL302 | 915 | 1060 | 990 | 988.3 | 1830.2 |
| 3 | 17CL303 | 940 | 1050 | 980 | 990.0 | 1833.3 |
| 4 | 17CL304 | 740 | 1160 | 965 | 955.0 | 1768.5 |
| 5 | 17CL305 | 1005 | 1195 | 1090 | 1096.7 | 2030.9 |
| 6 | 17CL306 | 1020 | 1360 | 1165 | 1181.7 | 2188.3 |
| 7 | 17CL307 | 770 | 670 | 735 | 725.0 | 1342.6 |
| 8 | 17CL308 | 960 | 925 | 945 | 943.3 | 1746.9 |
| 9 | 17CL309 | 940 | 900 | 915 | 918.3 | 1700.6 |
| 10 | Ch. Masoor | 915 | 840 | 905 | 886.7 | 1642.0 |
| 11 | Markaz-09 | 910 | 1055 | 975 | 980.0 | 1814.8 |
| 12 | Punjab-Masoor | 735 | 980 | 880 | 865 | 1601.9 |

The results indicated that the entry 17CL-306 exceeded all the genotypes by producing maximum yield (2188.3 kg/ha) followed by entry 17CL-305 ( 2030.9 kg/ha) while lowest yield was noted in entry Punjab Masoor (1601.9 kg/ha).

### 4.CHICKPEA MICRO YIELD TRIAL 2019-20

Chickpea (K) Micro Yield Trial was received from Director BARI, Chakwal. The trial comprised of thirteen entries including two check varieties. The trial was sown on 22-

10-2019 and harvested on 04-05-2020. The data regarding yield was calculated (Table 16) and send to quarter concerned.

**Table 16: Grain Yield in CMYT 2019-20**

| Sr. No. | Entry | Grain Yield (g/plot) | | | | Grain Yield (Kg/ha) |
|---|---|---|---|---|---|---|
| | | RI | RII | RIII | Mean | |
| 1 | 17KCC102 | 742 | 623 | 635 | 666.67 | 1234.57 |
| 2 | 17KCC104 | 654 | 642 | 640 | 645.33 | 1195.06 |
| 3 | 17KCC106 | 564 | 600 | 572 | 578.67 | 1071.60 |
| 4 | 17KCC107 | 553 | 480 | 515 | 516.00 | 955.56 |
| 5 | 17KCC109 | 525 | 477 | 525 | 509.00 | 942.59 |
| 6 | 17KCC112 | 519 | 586 | 565 | 556.67 | 1030.86 |
| 7 | 17KCC113 | 525 | 467 | 508 | 500.00 | 925.93 |
| 8 | 17KCC114 | 534 | 613 | 580 | 575.67 | 1066.05 |
| 9 | 17KCC118 | 528 | 545 | 540 | 537.67 | 995.68 |
| 10 | 17KCC120 | 626 | 533 | 581 | 580.00 | 1074.07 |
| 11 | 17FCK05 | 651 | 645 | 660 | 652.00 | 1207.41 |
| 12 | NOOR-13 | 535 | 533 | 545 | 537.67 | 995.68 |
| 13 | TAMMAN-13 | 584 | 568 | 602 | 584.67 | 1082.72 |

The results indicated that the entry 17KCC102 exceeded all the genotypes by producing maximum yield (1234.57 kg/ha) followed by 17FCK05 (1207.41 kg/ha) while lowest grain yield was observed in 17KCC113 (925.93 kg/ha).

## 5.CHICKPEA ZONAL YIELD TRIAL 2019-20

Chickpea Zonal Yield Trial was received from Director Agriculture, RARI, Bahawalpur that comprised of eight coded entries. The trial was sown on20-11-2019 and harvested on 06-05-2020. Yield data was recorded and send to quarter concerned (Table17):.

**Table 17: Grain Yield in CZYT 2019-20**

| Sr. No. | Entry | Grain Yield (g/plot) | | | | Grain Yield (Kg/ha) |
|---|---|---|---|---|---|---|
| | | RI | RII | RIII | Mean | |
| 1 | A | 492 | 373 | 385 | 416.67 | 1157.41 |
| 2 | B | 404 | 392 | 390 | 395.33 | 1098.15 |
| 3 | C | 314 | 350 | 322 | 328.67 | 912.96 |
| 4 | D | 303 | 230 | 265 | 266.00 | 738.89 |
| 5 | E | 275 | 227 | 275 | 259.00 | 719.44 |
| 6 | F | 269 | 336 | 315 | 306.67 | 851.85 |
| 7 | G | 275 | 217 | 258 | 250.00 | 694.44 |
| 8 | H | 284 | 363 | 330 | 325.67 | 904.63 |

The results indicated that the entry coded. A exceeded all the genotypes by producing maximum yield (1157.41 kg/ha) followed by entry B (1098.15 kg/ha) while lowest yield was noted in entry no. G (694.44 kg/ha).

**GRAM BREEDING RESEARCH SUB-STATION, ATTOCK**

**Overview**

Gram is an important crop of Pothohar region. Research on pulses is mainly conducted by Pulses Research Institute, Faisalabad. Gram Breeding Research Attock provides a unique opportunity for screening of the germplasm against the major disease “Gram Blight” as this disease was first identified in Pakistan in this region during 1916. The efforts of the sub-station have contributed in development of three disease resistant high yielding varieties of Gram i.e. Balkassar-2000, Wanhar-2000, Tamman.

**Objectives**

- Strengthening of gene pool of diverse origin.
- Development of high yielding and disease resistant varieties.
- Evaluation and screening of advance promising lines from NARC, BARI, Chakwal, NIAB and Pulses Research Institute, Faisalabad.

**(A) BREEDING**

## 1.Maintenance of Chickpea (Kabuli) Germplasm

Chickpea (Kabuli) germplasm comprising of 76 varieties/advance lines were sown on 21-10-2019 to maintain their seed. Recommended crop management practices were adopted. Data on different agronomic characteristics were recorded. Some entries were used for making fresh crosses. At maturity, the seed of all the lines/varieties was collected, dried, cleaned and stored properly. Traits variability range observed in the germplasm is as under (Table 1):

**Table 1: Traits diversity present in the germplasm**

| Sr. No. | Character Studied | Minimum | Maximum |
|---|---|---|---|
| 1 | Plant height (cm) | 45 | 102 |
| 2 | Days to flowering (50%) | 85 | 106 |
| 3 | Primary branches/plant | 4 | 7 |
| 4 | Secondary branches/plant | 10 | 30 |
| 5 | Pods/plant | 27 | 52 |
| 6 | No. of seeds/ pod | 1 | 3 |
| 7 | Days to maturity (90%) | 185 | 207 |
| 8 | 100 seed weight (g) | 15 | 27 |
| 9 | Seed yield (kg/ha) | 645 | 1050 |

## 2.Crossing Block.

Five crosses were performed among selected genotypes to induce genetic variability, incorporate drought tolerance and blight resistance into chickpea. Recommended crop management practices were adopted for healthy crop stand. At maturity, four successful crosses were harvested for their evaluation in filial generations.

## 3.Study of Filial Generations.

To evaluate and select desirable recombinants, early (F1 – F3) and advance (F4 – F7) generations were evaluated in the field.

### ii. Early Generations (F1 – F2)

#### a) $F_1$ Generation

Five crosses were studied. At maturity, the seed of all of the five crosses was collected for further evaluation in F2 generation.

#### b) $F_2$ Generation

$F_2$ populations of 5 crosses were sown in the field. Recommended crop management practices were adopted. Maximum segregation was

observed in the population. Segregating populations of chickpea were evaluated against blight resistant and plants/progenies were selected.

**c) Advance Generations ($F_3$ to $F_7$)**

In $F_3$ generation, 10 plants/progenies were sown in single row progeny lines with 20 cm plant spacing. Recommended crop management practices were adopted for healthy crop stand. Field observations were recorded for desirable traits. At maturity, 12 single plant selections were made for further studies in subsequent filial generation.

Similarly, in $F_4$ 16 plants/progenies were studied and Single plants were selected on field performance basis. Twenty-one (21) progenies of $F_5$ generations were evaluated for desirable traits and 25 best performing were selected for studies. In $F_6$ generation 30 plant progenies were studied and 34 were selected for further advancement.

## B.OUT STATIONS YIELD TRIALS.

### 1.NARC Chickpea Adaptation Trial 2019-20

The trial was received from NARC, Islamabad to evaluate the performance of twenty gram candidate lines for yield, disease resistance, drought conditions and adaptability under wide range of environmental conditions. They were sown on 29-10-2019 and harvested on 06-05-2020. The data regarding yield (Table 2) was calculated and send to quarter concerned.

**Table 2: Grain Yield in CAYT 2019-20**

| Sr. No. | Entry | Grain Yield (g/plot) | | | Grain Yield (Kg/ha) |
|---|---|---|---|---|---|
| | | RI | RII | Mean | |
| 1 | 1 | 171 | 223 | 197 | 1313.33 |
| 2 | 2 | 172 | 186 | 179 | 1193.33 |
| 3 | 3 | 71 | 123 | 97 | 646.67 |
| 4 | 4 | 77 | 74 | 75.5 | 503.33 |
| 5 | 5 | 80 | 100 | 90 | 600.00 |
| 6 | 6 | 138 | 86 | 112 | 746.67 |
| 7 | 7 | 73 | 132 | 102.5 | 683.33 |
| 8 | 8 | 92 | 167 | 129.5 | 863.33 |
| 9 | 9 | 101 | 188 | 144.5 | 963.33 |
| 10 | 10 | 80 | 74 | 77 | 513.33 |
| 11 | 11 | 163 | 138 | 150.5 | 1003.33 |
| 12 | 12 | 75 | 126 | 100.5 | 670.00 |
| 13 | 13 | 70 | 72 | 71 | 473.33 |

| | | | | | |
|---|---|---|---|---|---|
| 14 | 14 | 166 | 133 | 149.5 | 996.67 |
| 15 | 15 | 114 | 159 | 136.5 | 910.00 |
| 16 | 16 | 104 | 111 | 107.5 | 716.67 |
| 17 | 17 | 132 | 199 | 165.5 | 1103.33 |
| 18 | 18 | 110 | 85 | 97.5 | 650.00 |
| 19 | 19 | 103 | 122 | 112.5 | 750.00 |
| 20 | 20 | 114 | 103 | 108.5 | 723.33 |

The results indicated that the entry no. 1 and 2 exceeded all the genotypes by producing maximum yield (1313.33 kg/ha and 1193.33 kg/ha) respectively while lowest yield was observed in entry no. 13 (473.33 kg/ha).

1.***Ascochyta Blight*** **screening Nursery Trial 2019-20**

One chickpea *Ascochyta Blight* screening nursery was received from NIAB, Faisalabad. It was comprised of 58 entries, out of which 5 entries were selected (Table 3). Standard agronomic practices were performed for the evaluation of these nurseries.

**Table 3: Results of Ascochyta *Blight* screening Nursery 2019-20**

| Sr. No. | Nursery | Entries | |
|---|---|---|---|
| | | Studied | Selected |
| 1 | Chickpea (k) Ascochyta Blight Screening Nursery 2019-20 | 58 | 8 |

**Horticultural Research Station, Naushera Soan Valley District Khushab**

**Overview**

Horticulture is the most important sub discipline of Agriculture sector on the globe. It counts to an enterprise of 80 billion dollars business activities and absorbs a high percentage of technical and non-skilled labour. It is the panacea for poverty alleviation, job creation and to cater the problem of drudgery on global level. It is crystal clear that developing countries like Pakistan can find the solution of existing economic degradation through advancement of Horticulture sector.

Horticultural Research Station is a part of salt range located at coordinates of 32$^{o}$ 34’00.31 N and 72$^{o}$ 08’22.03 E at an elevation of 2641ft above sea level. It is equipped with soothing climatic conditions which are conducive for the development of Horticulture sector in the area. Sensing the potential of the area Horticulture

Research Sub-station was established in 1971 which was upgraded as a full fledge Research station 1984.

Presently the main field of the research activities being conducted at the station is detailed as under;

- Introduction, acclimatization, screening and development of deciduous fruits production technology including Peach, Pear, Plum, Apricot, Grapes, Almond etc.
- Olive propagation, value addition and Olive groves plantation and its promotion on commercial footings.
- Maintenance and management of germplasm unit of Peaches at Khatwai. A continuity of the Fruit and Vegetable development project in Punjab.
- Maintenance and management of GPU of peaches at Sodhi.
- Multiplication of true to type nursery fruit plants and its distribution.
- Standardization of cultural and plant protective measures of different deciduous fruits.
- Value addition of olive i.e. Pickle, Murabba and Jam.

## A. RESEARCH ACTIVITIES

The following research trails were conducted during 2019-20

### 1.EFFECT OF PRUNING INTENSITY ON BEARING POTENTIAL OF OLIVE cv. FRONTOIO

The experiment was conducted to study the impact of different pruning intensities on fruiting behavior of olive. Pruning of olives were carried out in February, 2019, applying four treatments i.e. Control (No Pruning T1), Light pruning (T2), Medium pruning (T3) and heavy pruning (T4). Light pruning consisted of approx. 15% pruning of dried, diseased and removal of crossed pencil sized branches. Medium pruning consisted of approx. 25-30% pruning of dried, diseased, crossed pencil sized branches and removal of central upright limbs. Heavy pruning consisted of approx. 50% pruning of dried, diseased, crossed pencil sized branches, central upright limbs and removal of crossed limbs. Data on flowering %, fruit set%, fruit volume ($mm^3$), fruit Weight (g) and yield (kg) was collected as shown in Table 1.

**Table 1: Effect of Pruning Intensity on Fruiting Parameters of Olive Cv. Frontoio**

| Treatments | Flowering % | Fruit set (%) | Fruit size ($cm^2$) | Fruit wt (g) | Yield (kg /pt) |
|---|---|---|---|---|---|
| **T1** | 85.45a | 2.28a | 2.21ab | 5.14a | 8.72ab |
| **T2** | 86.01a | 2.33a | 2.19b | 5.30a | 6.58b |
| **T3** | 83.88a | 2.36a | 2.21ab | 5.36a | 7.64b |
| **T4** | 85.19a | 2.56a | 2.20a | 5.42a | 10.38a |

Means followed by a same letter within columns are not significantly different at *P=0.05*(LSD)

Data showed that flowering % and fruit weight was not significantly affected by pruning intensity whereas fruit size and yield were significantly affected by pruning.

**2.EFFICACY OF DIFFERENT PREVENTIVE MEASURES FOR CONTROL OF FRUIT FLY IN PEACH**

Different preventive measures were applied for effective control of Peach fruit fly. In peach five various treatments i.e. Phermone (Methyl Eugenol) traps @ 6 traps/Acre (T1), fruit slice + Spinosid (Insecticide) (T2), Molasses + Spinosid (Insecticide) (T3), Sanitation at weekly Intervals (T4) and Protein Hydrolysate (300ml) + Spinosid (10ml) + water (9.690 L)(T5) were used. All these treatments were applied in the last week of April, 2019 at the onset of fruit fly season. Data to count the trapped flies was recorded on weekly basis. The results were compared to find out best preventive measure to control fruit fly effectively as shown in figure 1. Monitoring of Peach Fruit Fly (Bactrocera zonata) was done.

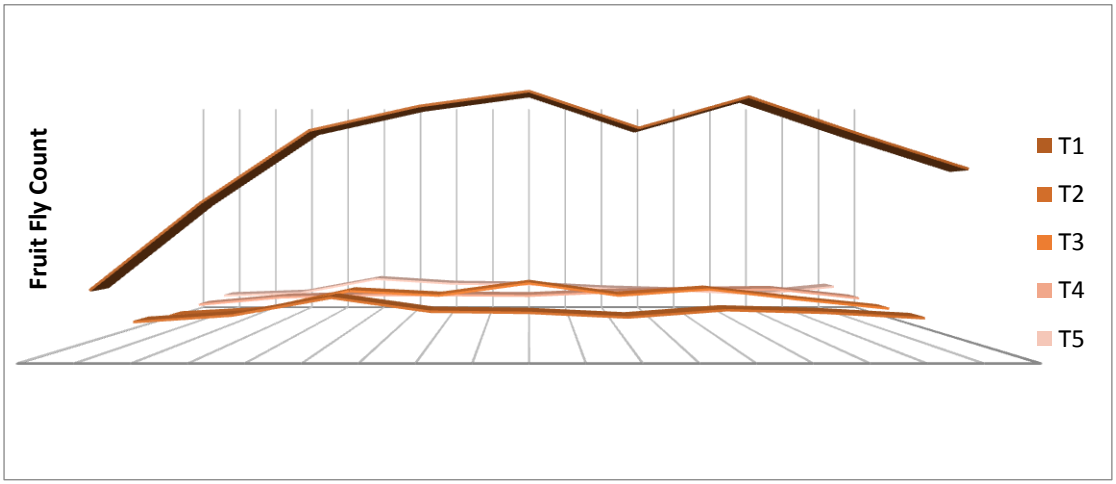


**Fig. 1: Efficacy of different preventive measures for control of fruit fly in peach**

**Table 2: Efficacy of Preventive Measures on Fruit Fly Count in Peach**

| | 4/29/19 | 5/6/19 | 5/13/19 | 5/20/19 | 5/27/19 | 6/3/19 | 6/10/19 | 6/17/19 | Mean |
|---|---|---|---|---|---|---|---|---|---|
| **T1** | 31.6 | 72.2 | 106.4 | 117.8 | 124.8 | 107.6 | 122.2 | 104.8 | 97.31 |
| **T2** | 11 | 14.4 | 23.6 | 16.4 | 15.8 | 13.4 | 17.2 | 15.8 | 15.62 |
| **T3** | 8.6 | 11.4 | 22.8 | 20.2 | 27.2 | 20.2 | 23.8 | 18 | 18.33 |
| **T4** | 10 | 14.6 | 16 | 16 | 15.6 | 17.8 | 19 | 19.6 | 15.84 |
| **T5** | 11.2 | 13 | 22.4 | 19.2 | 18.6 | 16 | 14.6 | 12.2 | 16.04 |

Highest fruit fly count was recorded in Phermone (Methyl Eugenol) traps @6 traps/Acre (T1) throughout the period of study. Fruit slice + Spinosid (Insecticide) (T2) had the lowest fly count. Hence Pheromone traps are most efficient for the control of fruit flies.

**3.EFFECT OF DIFFERENT CONCENTRATIONS OF *MORINGA OLIEFERA* LEAF EXTRACT ON ROOTING OF OLIVE CUTTINGS cv. FRONTOIO**

An experiment was conducted to find out the most suitable concentration of moringa leaf extract on rooting of olive, this trail was proposed. Different concentrations of MLE (0%, 100%, 75%, 50% and 25%) were used to treat terminal olive cuttings of Frontoio for three minutes during the month of April, 2019 and were planted in earthen pots containing soil media (sand, silt & FYM). Data were collected on the following parameters after six months.

**Table 3: Effect of different concentrations of *Moringa oliefera* leaf extract on rooting of olive cuttings cultivar Frontoio**

| Treatments | Sprouting (%) | Rooting (%) | Cuttings with Callus | Root Length (cm) | Roots per cutting |
|---|---|---|---|---|---|
| **T1** | 40.0 ab | 1.5 a | 1.7 a | 2.18 a | 1.75 a |
| **T2** | 40.0 ab | 2.25 a | 0.5 a | 4.12 a | 0.85 a |
| **T3** | 60.0 a | 3.25 a | 1 a | 4.76 a | 1.41 a |
| **T4** | 20.8 b | 1.5 a | 1 a | 6.20 a | 1.16 a |

| | | | | | |
|---|---|---|---|---|---|
| **T5** | 42.5 ab | 3 a | 1 a | 4.48 a | 1.37 a |
| **Mean** | 40.65 | 2.30 | 1.05 | 4.35 | 1.31 |

Means followed by a same letter within columns are not significantly different at *P=0.05*(LSD)

Data depicted that different concentrations of MLE did not have any significant on rooting %, root length and no. of roots per cuttings; however, 75% MLE significantly increased sprouting percentage.

**4. Adoptability Studies of Cherry Under Soon Valley Climatic Conditions**

This experiment was conducted to study the growth and fruiting behaviour of cherry under local climate. Different growth and yield parameters of Cherry cv. “Sasha”, planted in January 2018 in the research area were studied (Table 4) to assess its performance and fruit potential in the area. Overall growth was satisfactory in all plants

**Table 4: Adoptability Studies of Cherries in Soon Valley**

| Replicates | Plant height (cm) | Plant width (cm) | Stock girth (cm) | Scion girth (cm) |
|---|---|---|---|---|
| **R1** | 235.00 | 88.00 | 11.43 | 2.73 |
| **R2** | 170.00 | 32.50 | 6.33 | 10.28 |
| **R3** | 277.00 | 8.75 | 1.45 | 1.20 |
| **R4** | 149.25 | 101.00 | 2.05 | 1.83 |

**5. Enhancing Rooting of Olive Cuttings Through Different Rooting Chemical**

To find out best rooting technique for rooting of olive cuttings, this trail was designed. Seven different treatments (Control (No Treatment), 3000 mg/l IBA, Ammonia Phosphate (5 g/l), Paclobutrazol (PBZ 100 mg/l), 3000 mg/l IBA + Ammonia Phosphate (5 g $L^{-1}$), 3000 mg/l IBA + Paclobutrazol (PBZ 100 mg/l) and 3000 mg/l IBA + Ammonia Phosphate (5 g/l) + Paclobutrazol (PBZ 100 mg/l)) were used in the experiment. Terminal cuttings (10 cm long) of Olive var. Nocellera were dipped in the treatment solutions given above for one minute during the month of April, 2019 and

planted in earthen pots and placed under mini PE tunnels. Data on the following parameters were recorded in October, 2019 as shown in Table 5:

**Table 5: Effect of different rooting chemicals on rooting of olive cuttings**

| Treatments | Sprouting (%) | Rooting (%) | Cuttings with Callus | Root Length (cm) | Roots /Cutting |
|---|---|---|---|---|---|
| **T1** | 50.0 ab | 11.2 | 0.5 a | 14.15 a | 1.58 b |
| **T2** | 47.5 ab | 25 | 0 a | 9.79 a | 2.91 ab |
| **T3** | 42.5 b | 40 | 0.5 a | 13.97 a | 3.75 ab |
| **T4** | 47.5 ab | 22.5 | 0.25 a | 13.20 a | 1.87 ab |
| **T5** | 45.0 ab | 30 | 0.25 a | 9.62 a | 3.22 ab |
| **T6** | 72.50 a | 40.00 | 0.25 a | 10.37 a | 4.88 a |
| **T7** | 42.5 b | 22.5 | 0 a | 13.95 a | 3.25 ab |
| **Mean** | 49.6 | 27.3 | 0.3 a | 12.2 | 3.1 |

Means followed by a same letter within columns are not significantly different at *P=0.05*(LSD)

Data indicated that sprouting, rooting and number of roots per cuttings was significantly higher in T6. Other parameters were not affected different treatments.

6. **Effect of Early Fruit-Zone Leaf Removal on Canopy Development and Fruit Quality In Grapes Cv. King's Ruby**

Time and intensity of leaves removal impact on grapes quality were studied in this trail. Fruit zone leaf removal was carried out at different stages of development (pre-bloom stage, bloom stage and 4 weeks after post-bloom stage). These three different timings of manual Fruit-zone leaf removal (FZLR) were evaluated with a no-removal control. Leaf removal consisted of complete removal of all leaves and lateral shoots in the fruit zone on both sides of the canopy at pre-bloom, bloom, and four weeks post-bloom stage (Table 6):

**Table 6: Effect of Early Fruit-Zone Leaf Removal on Canopy Development And Fruit Quality In Grapes Cv. King's Ruby**

| Treatments | Fruit set (%) | Lateral Shoots | TSS | Bunch-rot (%) | Bunch wt (g) |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| **T1** | 47.79a | 6.75a | 20.83a | 4.12a | 259.37c |
| **T2** | 43.65b | 3.37d | 18.71b | 2.90b | 339.7a |
| **T3** | 43.97b | 4.12c | 19.3b | 1.54c | 334.2a |
| **T4** | 48.07a | 5.62b | 19.46b | 0.94c | 276.7b |

Means followed by a same letter within columns are not significantly different at *P=0.05*(LSD)

Fruit set % in T1 and T4 was greater than T2 and T3. Significant difference was observed in lateral shoots in all the treatments. TSS and bunch rot incidence also significantly differed in control from all of the remaining treatments. Bunch weights recorded in T2 and T3 were significantly greater than the other two treatments.

## 7. Effect of Foliar Application of Micronutrients on Growth and Quality of Peach

A field trail was conducted on peach to enhance growth and fruit quality. Zinc, iron, boron and copper were foliar applied in combination at different concentrations (0.5%, 1%, 1.5% and 2%) and these treatments were compared with control (no application). The given variety plants were sprayed at pre-bloom and full bloom stage. Foliar applications of micronutrients were used accorded to RCBD statistical design (Table7).

**Table 7: Effect of foliar application of micronutrients on growth and quality of peach**

| Treatments | TSS | Acidity | Vitamin C | Fruit Diameter (cm) | Fruits / Tree | Yield (kg) |
|---|---|---|---|---|---|---|
| **T1** | 7.26b | 0.33ab | 4.90c | 3.90c | 333.25c | 42.13b |
| **T2** | 8.35a | 0.26b | 5.96a | 4.78a | 482.75ab | 76.10a |
| **T3** | 7.737ab | 0.36a | 5.29abc | 5.03a | 536.75a | 71.47a |
| **T4** | 7.55ab | 0.33ab | 5.63ab | 4.32b | 486.25ab | 68.39a |
| **T5** | 7.59ab | 0.31ab | 5.26bc | 4.31b | 426.00b | 63.47a |

Means followed by a same letter within columns are not significantly different at *P=0.05*(LSD)

Data indicates that significant difference was observed in respect of TSS and Acidity with the application of micronutrients. Maximum TSS and minimum acidity was observed in T2 (0.5 % $ZnSO_4$+ 0.5 %$FeSO_4$+ 0.5 % $H_3BO_3$+ 0.5 % CuSO4). Similarly Vitamin C content and fruit diameter significantly differed within treatments. T2 (0.5 % $ZnSO_4$+ 0.5 %$FeSO_4$+ 0.5 % $H_3BO_3$+ 0.5 % CuSO4) increased Vitamin C upto 5.9675 (mg/100 ml of juice) but maximum fruit diameter and fruits/tree were recorded in T3 ( 1 % $ZnSO_4$+ 1 %$FeSO_4$+ 1 % $H_3BO_3$+ 1 % $CuSO_4$). There was significant difference among all treatments in respect of yield.

8. **Effect of Different Rooting Media On Rooting Of Olive Cuttings Cv. Fronotio (*Olea Europea*)**

This study was also conducted to evaluate different natural rooting media for olive. Control (No dipping), Aloevera Gel (AVG) 100 g/L, Moringa leaf extract (MLE) 100 g/L, Willow Bark Extract (WBE) 100 g/L, AVG +MLE (100 + 100 g/L) and AVG +MLE+WBE (100+100+100 g/L) were used. Terminal cuttings (10 cm long) of olive variety Frontoio were dipped in different rooting Media for twenty four hours during the month of March and planted in earthen pots. Data will be collected on the following parameters.

**Table 9: Effect of Different Rooting Media on Rooting of Olive Cuttings Cultivar Fronotio (*Olea Europea*)**

| Treatments | Sprouting (%) | Rooting (%) | Cuttings with Callus | Root Length(cm) | No of Roots/Cutting |
|---|---|---|---|---|---|
| **T1** | 40. a | 15 a | 0.5 a | 14.15 a | 2.08 a |
| **T2** | 40. ab | 35 a | 0 a | 10.89 a | 3.41 a |
| **T3** | 62 b | 40 a | 0.75 a | 14.51 a | 3.75 a |
| **T4** | 37 b | 40 a | 0.25 a | 14.73 a | 2.87 a |
| **T5** | 40 b | 35 a | 0.25 a | 11.87 a | 3.57 a |
| **T6** | 72 b | 40 a | 0.5 a | 13.39 a | 5.12 a |
| **Mean** | 48.50 | 34.17 | 0.38 | 13.26 | 3.47 |

Means followed by a same letter within columns are not significantly different at *P=0.05*(LSD)

9. **Supply of Certified Fruit Plants**

Certified peach plants of Early Grand and Florida King duly certified from FSC&RD are provided to growers. Apart from these, certified plants of olive, grapes, nectarine, plum, apricot, fig and pomegranate are also produced at the station.

## 10. VARIETY REGISTRATION

A variety of Fig namely “Black Ball” was got registered from FSC& RD as shown in Figure 1:

**Figure 1: Fig cultivar “Black ball”**

## 11. GPU of Peaches at Khatwai

Fruit and vegetable development project was initiated during 2006-2007. After screening sixteen varieties 8 are included in the multiplication block of GPU. Four varieties i.e. Early Grand, Florida King, A-669, and Plain-4 have been registered.

**Table 10: GPU of Peaches at Khatwai**

| Sr No. | Variety name |
|---|---|
| 1 | Early Grand |
| 2 | Ryan Sun |
| 3 | Alberta |
| 4 | Indian blood |
| 5 | coronet |

| | |
|---|---|
| 6 | Florida Gold |
| 7 | A-669 |
| 8 | Florida king |

## 12. GPU of Peaches at Sodhi

Owing to the shortage of water at Khatwai new land for GPU has been acquired at Sodhi. One block each of Early Grand and Florida king have been planted for the supply of bud wood to growers and registered.

View of GPU for peaches at Sodhi

View of GPU at Khatwai

**Figure 2: GPU of Peaches at Sodhi &Khatwai**

## HILL FRUIT RESEARCH STATION SUNNY BANK MURREE

### Overview

Hill Fruit Research Station Murree is the premier research center in the Punjab Province for temperate fruits and is endeavoring hard for the progress and Improvement of plantation of high quality fruit in Murree hills area where avocado, apple and other hill fruits are successfully produced .The station was initiated as progeny garden in 1946 and upgraded as sub-station in 1952 under the then Fruit Specialist, Faisalabad. In year 1984 it was upgraded as station in order to strengthen the ongoing work.

The main objectives of the Hill Fruit Research Station, Murree are as under:

- Collection and Maintenance of germplasm of temperate fruit crops
- Introduction, acclimatization and selection of high yielding varieties

- To evolve appropriate production technology for deciduous fruits
- Supply of Pedigree fruit plants of recommended cultivars to the farmer at cheaper rates
- To conduct Research trials on Different aspects of temperate/ deciduous fruit.

**1.Propagation of Avocado *(Persea Americana)* By Different Techniques of Grafting**

The experiment was started in 2015 to produce true to type avocado plants through asexual propagation method using different grafting techniques. Experiment was laid out according to Randomized Complete Block Design. (RCBD) having four replications using twenty cuttings for each treatment.

$T_1$= Cleft Grafting

$T_2$= T-Grafting

$T_3$= Side Grafting

Data revealed (Table 1, 2 & 3) that $T_2$ (Tongue grafting) showed maximum success percentage (25 %), maximum number of leaves (4.5) and maximum shoot length (1.8 cm)

**Table 1: Success percentage Propagation of Avocado *(Persea Americana)* By Different Techniques of Grafting**

| **Treatments** | **$T_1$(Cleft Grafting)** | **$T_2$(Tongue-Grafting)** | **$T_3$(Side Grafting)** |
|---|---|---|---|
| $R_1$ | 20 | 25 | 0 |
| $R_2$ | 25 | 20 | 0 |
| $R_3$ | 20 | 30 | 0 |
| $R_4$ | 15 | 25 | 0 |
| Mean | 20 | 25 | 0 |

**Table 2: No. of Leaves per plant after 30 days Propagation of Avocado *(Persea Americana)* By Different Techniques of Grafting**

| **Treatments** | **$T_1$(Cleft Grafting)** | **$T_2$(Tongue-Grafting)** | **$T_3$(Side Grafting)** |
|---|---|---|---|
| $R_1$ | 5 | 4 | 0 |

| | | | |
|---|---|---|---|
| $R_2$ | 4 | 3 | 0 |
| $R_3$ | 5 | 4 | 0 |
| $R_4$ | 4 | 5 | 0 |
| Mean | 4.5 | 4 | 0 |

**Table 3: Shoot length (cm) after 30days Propagation of Avocado *(Persea Americana)* By Different Techniques of Grafting**

| Treatments | $T_1$(Cleft Grafting) | $T_2$(T-Grafting) | $T_3$(Side Grafting) |
|---|---|---|---|
| $R_1$ | 1.5 | 1.0 | 0 |
| $R_2$ | 2.5 | 1.5 | 0 |
| $R_3$ | 1.2 | 2.2 | 0 |
| $R_4$ | 2.0 | 1.0 | 0 |
| Mean | 1.8 | 1.425 | 0 |

**2. Varietal Comparison of Different Varieties of Avocado *(Persea Americana)* At Lower Hills of Murree (Tret)**

The experiment was designed to find better variety of avocado at lower altitude of Murree. The experiment was laid out according to Randomized Complete Block Design. (RCBD) having one replication with one plant / treatment.

Following treatments were used in the experiment:

$V_{1=}$ Selection I $V_{2=}$ Selection II $V_{3=}$ Selection III

$V_{4=}$ Selection IV $V_{5=}$ Selection V $V_{6=}$ Selection vi

Data revealed (Table 4) that $V_2$ (Selection II) and $V_4$ (Selection IV) were the early varieties with fruit maturity. $V_1$ (Selection I) gave maximum fruit length (16.27) and fruit weight (484) while V4 (Selection 4) give the minimum fruit yield (323). While in $V_6$ (Selection IV), seed to pulp ratio is minimum (5)

**Table 4: Varietal Comparison of Different Varieties of Avocado *(Persea Americana)* At Lower Hills of Murree (Tret)**

| Sr.# | Flowering time | Fruit set time | Maturity time | Skin color | Fruit length (cm) | Fruit breadth (g) | Fruit weight (g) | Seed weight (g) | Seed/ pulp ratio |
|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| $V_1$ | Mid Mar | Mid May | Start Sep | Purple | 16.27 | 7.89 | 484 | 71 | 5.81 |
| $V_2$ | Mid Mar | Start May | End Aug | Green | 5.0 | 2.4 | 210 | 26.4 | 12.0 |
| $V_3$ | End Mar | Mid May | Start Sep | Purple | 13.59 | 8.63 | 393 | 69 | 4.69 |
| $V_4$ | Mid Mar | Start May | End Aug | Purple | 15.88 | 7.14 | 323 | 63 | 4.0 |
| $V_5$ | Start Apr | Mid May | Start Sep | Green | 3.5 | 1.9 | 110 | 12.2 | 10.2 |
| $V_6$ | Start Apr | Mid May | Start Sep | Purple | 11.27 | 7.14 | 387 | 65 | 5 |

### 3. Performance of Different Olive Varieties at Lower Hills, Murree

The experiment was included in the research programme to evaluate the olive varieties for commercial cultivation. The experiment was laid out according to RCBD having one replication with three plants / treatment. Following treatments were used in the experiment.

$T_{1=}$ Ottobratica $T_{2=}$ Frontio $T_{3=}$ Leccino

$T_{4=}$ Pendolino $T_{5=}$ Coratino

Data revealed (Table 5 & 6) that maximum shoot length (5.58) was found in $T_1$. Number of leaves was maximum (34) in $T_5$ and length of leaves (5.58) was maximum in $T_1$. Stem girth (66.04) was higher in T5 while stock girth (58.42) was higher in $T_4$. While $T_4$ has been proved as late variety regarding flowering time, fruit set and color break as compared to all others. $T_1$ was superior variety with regard of fruit length (3.7), fruit breadth (2.0) and fruit weight (3.2).

**Table 5: Plant characteristics of Different Olive Varieties at Lower Hills, Murree**

| Sr.# | Shoot length (m) | No. of leaves (on 30 cm) | Leaf length (cm) | Leaf width (cm) | Stem girth (cm) | Stock girth (cm) |
|---|---|---|---|---|---|---|
| $T_1$ | 40.64 | 28 | 5.58 | 1.27 | 30.48 | 16.76 |

| | | | | | | |
|---|---|---|---|---|---|---|
| $T_2$ | 50.08 | 26 | 5.08 | 1.524 | 73.93 | 45.72 |
| $T_3$ | 45.72 | 25 | 5.8 | 1.524 | 55.88 | 50.8 |
| $T_4$ | 43.18 | 28 | 5.08 | 1.27 | 60.96 | 58.42 |
| $T_5$ | 43.18 | 34 | 5.08 | 1.27 | 66.04 | 43.18 |

**Table 6: Plant characteristics of Different Olive Varieties at Lower Hills, Murree**

| Sr. # | Flowering time | Fruit set time | Time of color break | Fruit length(cm) | Fruit breadth(cm) | Fruit weight (g) |
|---|---|---|---|---|---|---|
| $T_1$ | Start Apr | Start May | Start Aug | 3.70 | 2.0 | 3.2 |
| $T_2$ | Start Apr | Start May | Start Aug | 2.95 | 1.75 | 2.50 |
| $T_3$ | Start Apr | Start May | Start Aug | 2.09 | 1.62 | 4 |
| $T_4$ | Mid Apr | Mid May | Mid Aug | 2.43 | 1.50 | 3 |
| $T_5$ | Start Apr | Start May | Start Aug | 2.01 | 1.60 | 3 |

**4.Strengthening of Gene Pool of Walnut Through Selection of New Walnut Varieties at Lower Altitude of Murree**

The experiment was included in the research programme to select new strain / variety having better quality characteristics. The experiment was laid out according to Randomized Complete Block Design. (RCBD) having three replications using three plants per treatment.

$V_1$= Walnut selection I

$V_2$= Walnut selection II

$V_3$= Walnut selection III

Data revealed (Table 7) that $V_1$ proved to be superior in all vegetative characteristics as compared to other two varieties

**Table 7: Plant characteristics of Walnut Through Selection of New Walnut Varieties at Lower Altitude of Murree**

| Treatments | Plant height (m) | Plant spread (cm) | Stock girth (cm) | Scion girth (cm) |
|---|---|---|---|---|
| $V_1$ | 2.59 | 275 | 21.59 | 15.24 |

| | | | | |
|---|---|---|---|---|
| $V_2$ | 1.55 | 104 | 12.7 | 8.89 |
| $V_3$ | 2.26 | 122 | 12.7 | 10.16 |

**5.Response of Different Olive Varieties on The Rooting of Their Cuttings**

The experiment included in the research plan to evaluate the best cultivar of olive for propagation through cuttings. Among all the eleven varieties, $T_1$ (Arbequina) surpassed all others depicting highest sprouting %age of 90. The rooting % age was noted maximum as (48.67 %), maximum root length (5.20cm) & success (36.33%) in $T_{11}$ (Ottobratica). While the highest number of roots was counted as (6.23) in $T_8$ (Koroneiki) as shown in Table 8.

**Table 8: Response of Different Olive Varieties on the Rooting of heir Cuttings**

| Sr.# | Variety | Sprouting %age | Rooting %age | No. of Roots/ Cutting | Length of Root (Cm) | Success %age |
|---|---|---|---|---|---|---|
| 1 | **Arbequina** | 89.67 | 47.67 | 5.73 | 3.47 | 30.67 |
| 2 | **Arbosana** | 76.67 | 48.33 | 3.53 | 2.53 | 29.33 |
| 3 | **Azerbaijan** | 57.33 | 33.33 | 4.57 | 3.53 | 24.67 |
| 4 | **FS-17** | 57.67 | 32.33 | 2.43 | 1.67 | 27.67 |
| 5 | **Gemlik** | 62.67 | 34.33 | 4.87 | 2.23 | 25.67 |
| 6 | **Gerboui** | 64.33 | 32.67 | 3.80 | 3.23 | 28.33 |
| 7 | **Hamadi** | 47.67 | 35.33 | 4.17 | 2.13 | 19.67 |
| 8 | **Koroneiki** | 72.67 | 43.67 | 6.23 | 4.13 | 34.33 |
| 9 | **Leccino** | 42.33 | 28.67 | 4.17 | 3.57 | 18.67 |
| 10 | **Manzanila** | 58.67 | 38.33 | 4.23 | 3.30 | 31.33 |
| 11 | **Ottobratica** | 75.67 | 48.67 | 6.10 | 5.20 | 36.33 |

**6.Response of Different Times on The True to Type Propagation of Avocado Through Arial Layering**

This experiment was included in the research plan to produce true to type plants through asexual propagation. The results (Table 9) showed that there is no growth in

March and August plantation while in April, May, June and August only primordial growth is observed.

**Table 9: Response of Different Times on The True to Type Propagation of Avocado Through Arial Layering**

| Treatments | No. of roots | Length of roots (Cm) | Success percentage |
|---|---|---|---|
| **$T_1$ = March** | Nil | Nil | Nil |
| **$T_2$ = April** | Primordial growth | Primordial growth | Primordial growth |
| **$T_3$ = May** | Primordial growth | Primordial growth | Primordial growth |
| **$T_4$ = June** | Primordial growth | Primordial growth | Primordial growth |
| **$T_5$ = July** | Primordial growth | Primordial growth | Primordial growth |
| **$T_6$ = August** | Nil | Nil | Nil |

**7.Studies on The Adaptation Potential of Avocado (*Persea Americana)* at Different Ecological Pockets in The Punjab**

Present project was initiated to study the performance and adoption of Avocado at various locations of the Punjab in the current era of climate change.

The experimental units comprising of three Avocado varieties, i.e., California Long, Ceylon Blue and Murree Gola has been transplanted at the selected sites/ different horticultural Institutes, Stations and Sub-Stations of the Punjab ranging from Northern district of Rawalpindi to the Southern area of Dera Ghazi Khan and Bahawalpur during the last week of February and 1$^{st}$ week of March, 2019. Furthermore, the plants are at initial stage. Once they are adapted to the condition data regarding vegetative and fruit characteristics were taken.

**Table 9: Adaptation Potential of Avocado (*Persea Americana)* at Different Ecological Pockets in The Punjab**

| | Mortality %age | | Survival %age | |
|---|---|---|---|---|
| | Sunny | Lower Topa | Sunny Bank | Lower Topa |

| | Bank | | | |
|---|---|---|---|---|
| California Long | 20 | 40 | 80 | 60 |
| Cylon Blue | 40 | 20 | 60 | 80 |
| Murree Gola | 20 | 20 | 80 | 80 |

**8.Propagation of Avocado Through Cuttings Using Different Concentrations of IBA**

Experiment was conducted during April and repeated in July to produce true to type avocado plants through asexual Propagation. Experiment was laid out according to Randomized Complete Block Design. (RCBD) having three replications with fifteen cuttings. The avocado variety used in this experiment was California Long. Following treatments were applied to (15 cm long) semi hardwood cuttings. The cuttings were then planted in plastic bags having sand and soil (50:50).

**Table 10: Cuttings planted in April**

| Treatments | Success %age | Shoot length (cm) | No. of leaves |
|---|---|---|---|
| $T_1$ = Control | 10 | - | 2 |
| $T_2$ = 1000mg/L | 10 | - | 2 |
| $T_3$ = 2000mg/L | - | - | - |
| $T_4$ = 3000 mg/L | 5 | - | 2 |
| $T_5$ = 4000mg/L | 5 | - | 2 |

**Table 11: Cuttings planted in July**

| Treatments | Success %age | Shoot length (cm) | No. of leaves |
|---|---|---|---|
| $T_1$= Control | 60 | - | 2 |
| $T_2$= 1000mg/L | 60 | - | 3.7 |
| $T_3$= 2000mg/L | 50 | - | 1.5 |
| $T_4$= 3000 mg/L | 50 | - | 3 |
| $T_5$= 4000mg/L | 60 | - | 2.6 |

Different levels of IBA, i.e., 1000, 2000, 3000 and 4000 mg/L were tested in the months of April and July to induce rooting for true to type propagation of Avocado.

Maximum sprouting percentage was observed as 60% in the cuttings planted during the month of July with a little number (3.7 leaves). But no rooting was seen in all treatments resulting in no success

**9.Performance Evaluation of Four Pecan Nut Varieties at Lower Hills, Murree**

Present project was initiated in 2019 to study the response of pecan varieties to Climatic condition of Murree. The maximum plant height was observed in Wachita (7 ft 3 inch) followed by DMA-1 (4.4 ft) and Shanee (3.3 ft). Regarding Stem girth best results were obtained in Wachita (3.5 inch followed by Shanee (2 inch).