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Overview

Wheat is the basic staple diet of Pakistani people and occupies prime position in food and economic security of the country as well as to frame agricultural policies of the government. This year cool and humid weather prolonged which was favorable for wheat crop. On the other side, yellow rust prevalence was recorded all over the province and some varieties like Galaxy-13, chakwal-50, Seher-06 and Punjab-11 were badly hit due to yellow rust. Untimely rains at harvesting time along with thunderstorms and hailstorms occurred which negatively affected wheat production.

Wheat Research Institute, Faisalabad has continuously made efforts to introduce new high yielding wheat and barley varieties and to advance production technology package. Two advanced lines of wheat (V-14154 and V-14124) have been spot examined and recommended for consideration in Experts Sub Committee meeting and one advanced line of wheat V-12304 has been cleared by experts sub committee for its final approval.

More than 80 experiments on different aspects like harvest plus, global warming, lodging tolerance, scarcity of irrigation, salt & aphid tolerance and durable rust resistance were conducted in different agro-ecological zones of the Punjab province under station and out station yield trials.

Wheat advanced lines

The final variety case of one wheat advanced line (V-12304) has been submitted to Punjab Seed Council for

final approval. The salient features of this advanced line is given below:

V-12304



It is high yielding wheat advanced line with good resistance against leaf, yellow and stem rusts. It is suitable for late sowing in irrigated areas of Punjab.

BREAD WHEAT (*Triticum aestivum* L.)

Maintenance of bread wheat germplasm

Germplasm improvement and maintenance provides an opportunity to incorporate the desirable genes in the existing varieties through hybridization. Germplasm maintenance and evaluation, covers the whole range of activities starting from collection of samples, its characterization, evaluation, and documentation. Our primary goal was to maintain genotypes/lines with their typical characteristic and to combine high yield, adaptability, tolerance to biotic and abiotic stresses, quality and other desirable traits.

Wheat hybrid studies

27 CMS lines were maintained by crossing with same number of maintainer (B) lines. 16 fertility restorers were also maintained by selfing.

Filial generations (F₁ – F₇)

Fresh crosses (F₀ generation) developed under different objectives were planted in irrigated conditions to get sufficient seed for planting next generation in specific conditions. Segregating generations from F₂ to F₇ were exposed

to artificial epidemic rusts conditions. Filial generations of specific crosses i.e., for drought and heat tolerance were sown in their respective environmental conditions and the data was recorded for rust reactions.

Station Yield Trials

Preliminary yield trials (Irrigated)

376 advanced lines of bread wheat, developed at Wheat Research Institute Faisalabad and selected from international nurseries, were tested in eight preliminary yield trials (A-Trials) under normal planting conditions. From these trials, emergence %, days to 50 % heading, days to maturity, plant height, lodging %, diseases incidence and grain yield (kg ha⁻¹) data were recorded.

Regular yield trials (Irrigated)

Ninety four advance lines of bread wheat were tested for emergence %, days to 50 % heading, days to maturity, plant height, lodging %, diseases incidence and grain yield (kg ha⁻¹) in two regular yield trials (B-Trials) under normal and late planting conditions.

SEED PRODUCTION

800 single head rows of advance lines and 800 single head rows of approved varieties were planted. Eight acres of Pre-basic seed production of approved varieties (Faisalabad-08, Punjab-11, Galaxy-13, Ujaala-16 and Anaaj-17) and ten acres of Basic seed production of approved varieties (Faisalabad-08, Punjab-11, Galaxy-13, Ujaala-16, Zincol-16 and Anaaj-17) were planted.

BREEDING FOR HEAT TOLERANCE

Filial generations (F2-F7)

About 260 fresh crosses were attempted to accumulate genes for high yield and heat tolerance. Selection of superior genotypes in heat filial generations viz; F₂ (254 entries), F₃ (78 entries), F₄ (48 entries) and F₅ (36 entries), F₆ (245 entries) and F₇ (104 entries) was made.

Evaluation of bread wheat germplasm for post-anthesis heat stress

Seventy bread wheat germplasm entries was sown as two rows of three meter length in and outside the tunnel during 1st fortnight of November 2018 in two replications. The same material was sown late outside the tunnel in the last week of December. Post anthesis heat shock was induced by covering the tunnel with clear poly propylene sheet for about three weeks. Data regarding days to heading, canopy temperature, normalized difference vegetation index, number of tillers plant⁻¹ plant height, rust reactions and days to maturity was recorded.

Short duration heat trial

A short duration heat trial (50 entries) was conducted with 2 checks (Faisalabad-06 and Shafaq-06) and 2 replications. Data of days to heading, maturity, lodging and disease score was recorded.

International Heat Nurseries/Trials

For strengthening heat tolerant bread wheat germplasm, three heat international nurseries/trials viz; 17th High Temperature Wheat Yield Trial,

19th Heat Tolerance Spring Bread Wheat Yield Trial, 19th Heat Tolerance Spring Bread Wheat Observation Nursery were sown according to the donor (CIMMYT, ICARDA) instructions. Data regarding days to heading, normalized difference vegetation index, canopy temperature, disease score, lodging %, plant height and days to maturity data was recorded. Selections of desirable lines on phenotypic bases were selected.

SHORT PRELIMINARY AND REGULAR WHEAT YIELD TRIAL (A-IX, B-I & B-II)

During this year, one A (IX), two B (I & II) trials of bread wheat was conducted under irrigated late sowing condition. The A (IX) trial consisted of 50 entries with 4 checks (Faisalaba-08, Inqalab-91, Ujala-16 and Seher-06) while B-I & II consisted of 3 checks (Faisalaba-06, Galaxy-13 and Anaj-17). The late planting was done (4th December 2018) following RCB design with three replications. Data regarding days to heading, disease score, lodging %, plant height and days to maturity data was recorded. Selections of desirable lines on phenotypic bases were selected.

Drought tolerance studies

Filial generations (DRF₁–DRF₇)

About 350 fresh crosses (F₀ generation) developed with the objective of drought tolerance in wheat. Segregating generations from DRF₂ to DRF₇ were exposed to artificial epidemic rust conditions. Thirty entries out of 84 in DRF₇, out of 819 DRF₆ single head rows 170, 57 entries out of 79 DRF₅, 110 entries out of 157 DRF₄ were selected on the basis of rust and

other agronomic features for further evaluation next year. Galaxy-13, Punjab-11 and Faisalabad-08 were sown as checks. Selection in DRF₃ and DRF₂ remained under progress.

Yield Trials

In preliminary yield trial under drought conditions, one hundred Twelve advanced lines of bread wheat along with check varieties viz., Galaxy-13 and Punjab 11 were sown on November 12, 2018 in two trials A-I and A-II with two replications following randomized complete block under split plot design under drought conditions. No irrigation was applied after sowing. All other agronomic practices were kept same.

In regular yield trial under drought conditions, fifty entries were tested following randomized complete block under split plot design with two replications. Galaxy-13, Punjab-11 and Faisalabad-08 were sown as checks.

Data regarding days to heading, germination percentage, canopy temperature, normalized vegetation Index (NDVI), disease scoring were recorded.

International Nursery/Trial

Three hundred entries from Semi-Arid Wheat Screening Nursery (SAWSN) received from CIMMYT were sown on November 27, 2018 in a plot size of one meter row.

Fifty entries of Elite Spring Bread Wheat Yield Trial (ESBWYT) were sown on November 22, 2018 in a plot size of 6 rows × 5m in a randomized complete block design with two replications.

Data regarding days to heading, germination percentage, canopy temperature, normalized vegetation Index (NDVI), disease scoring were recorded.

International nurseries/ trials

39th Elite Spring Wheat Yield Trial (39th ESWYT)

39th ESWYT comprising of 50 entries including local check variety Faisalabad-08 were planted in 2 replications with plot size of 5m x 6rows. The trial was sown on 20th November 2018.

26th Semi Arid Wheat Yield Trial (26th SAWYT)

26th SAWYT comprising of 50 entries including local check variety Faisalabad-08 was planted in 5m x 6rows plot size with 2 replications. The trial was sown on 20th November 2018.

6th Wheat Yield Consortium Yield Trial (6th WYCYT)

6th WYCYT comprising of 30 entries including local check variety Faisalabad-08 was planted in 5m x 6rows plot size with 2 replications.

8th Stress Adaptive Trait Yield Trial Nursery (8th SATYN)

8th SATYN comprising of 33 entries were planted in 2 replications with plot size of 5m x 6rows. The trial was sown on 20th November 2018.

5th International Bread Wheat Screening Nursery (5th IBWSN)

5th IBWSN comprising of 300 entries were planted on 28th November 2018 with plot size of 2m x 2rows.

National Research Yield Trial (NRYT)

NRYT comprising of 50 entries were planted in 2 replications with plot size of 5m x 6rows. The trial was sown on 20th November 2018.

DURUM WHEAT (*Triticum durum* Desf.)

Maintenance of germplasm and hybridization

The main objective of research work on durum is to develop high yielding, good quality and disease resistant wheat varieties. Two hundred and thirty four (234) cultivars/ advanced lines of durum and triticale were sown to make the desirable cross combinations. Fifty-seven (50) crosses were attempted for next year's planting.

FILIAL GENERATIONS (F₁-F₇)

F₁ generation

Fifty-three crosses were planted in a single row of 2.5 m length along with their parents to compare their morphology and vigor. Thirty crosses having desirable traits were harvested to advance the generation.

F₂-F₇ generations

Filial generations (F₂-F₇) were sown and selected for desirable traits. Segregating materials were surrounded by the spreader rows of highly susceptible variety (Morocco). Modified bulk method was used for selection in F₂, F₃ and F₄ generations. From F₅, disease

resistant and desirable heads were selected to raise single head rows of F₆ generation. Thirty-two entries of F₂ generation were studied. In F₃ generation, 18 entries were studied. In F₄ generation, 12 crosses were selected from 18 crosses to advance the generation. In F₅ generation, 250 single heads of 11 crosses were selected out of 20 crosses. Similarly, in F₆ generation 263 single head rows were studied.

Preliminary yield trial

Two yield trials were conducted for durum wheat in which 30 entries were tested against three check varieties (Durum-97, Wadanak-85 and Ujala-16).

Regular yield trial

Fifteen advanced lines of durum wheat were tested in regular yield trial against three check varieties (Durum-97, Wadanak-85 and Ujala-16).

50th International durum yield nursery

During 2018-19, 50th international durum yield nursery was received from CIMMYT comprising of 50 lines.

50th International durum screening nursery

During 2018-19, 50th international durum screening nursery was received from CIMMYT comprising of 164 entries.

BARLEY (*Hordeum vulgare*)

Maintenance and improvement of barley germplasm

Eighty genotypes were planted and off type plants were rogued out. The average germination percentage was recorded at 95% and days to heading ranged between 88 to 111 days.

Filial generations

In filial generations, 5 entries of F₅, 17 entries of F₆ and 9 entries of F₇ were planted in the field. The average germination percentage was recorded at 92%.

Preliminary yield trial of barley (A-trial)

Thirty advanced lines of barley were sown in two experiments A₁ and A₂ with check varieties Sultan-17 and Haider-93. The average germination percentage was recorded at 96% and days to heading ranged between 99 to 107 days.

Advanced yield trial of barley (B-trial)

In this experiment fifteen advanced lines of barley were sown with check varieties Sultan-17 and Haider-93. The average germination percentage was recorded at 97% and days to heading ranged between 95 to 106 days.

Barley sowing date trial

Ten advanced barley lines along with check varieties Sultan-17 and Haider-93 were planted in this experiment with 15 days interval. The average germination percentage was recorded at 95% and days to heading ranged between 94 to 106 days.

Punjab Uniform Barley Yield Trial (PUBYT)

Fourteen advanced lines of barley were sown in this experiment with check varieties Sultan-17 and Haider-93 at different five districts of Punjab. The average germination percentage was recorded at 94% and days to heading ranged between 97 to 105 days at Wheat Research Institute, Faisalabad.

National Uniform Barley Yield Trial (NUBYT)

Nine coded entries of barley were sown in this experiment. The average germination percentage was recorded at 93% and days to heading ranged between 97 to 105 days at Wheat Research Institute, Faisalabad.

Barley rainfed yield trial

Fourteen advanced lines of barley were sown in this experiment with check varieties Sultan-17 and Haider-93 in normal irrigated and rainfed conditions. The average germination percentage was recorded at 94% and days to heading ranged between 97 to 107 days.

Barley international nurseries/ yield trials

Two barley international yield trials were sown in this experiment and the average germination percentage recorded was 95% while the days to heading of different entries ranged between 92 to 108 days.

Wheat Agronomy

Effect of climate change on sowing time of wheat crop

The trial was conducted to find out the best sowing time for newly developed wheat lines under changing climate scenario. Ten newly developed wheat lines viz. V-12304, V-14154, V-14124, V-15235, V-15166, V-16005, V-15309, HYT-60-57, HYT-60-5, HYT-20-19 and HYT-55-33 along with three check varieties i.e. Fsd-08, Galaxy-13 and Anaj-17 were planted seven times starting from 1st November to 30th December with ten days interval.

Response of seed rate on grain yield of advanced wheat lines

Six advanced lines i.e. V-14154, V-14124, V-15235, HYT-60-5, HYT-

60-5 and HYT-60-57 with one check variety viz. Fsd-08 were tested along with four seed rates. Viz. 75, 100, 125, 150 kg ha⁻¹ were tested.

Response of Fertilizer on grain yield of advanced wheat lines

The trial was conducted on mid-November to explore optimum fertilizer requirement of Six advanced lines i.e. V-14154, V-14124, V-15235, HYT-60-5, HYT-60-5 and HYT-60-57 with one check variety viz. Fsd-08 along with four NPK levels (0-0-0, 90-60-60, 120-90-60, 150-120-60) kg ha⁻¹.

Effect of irrigation scheduling on different growth stages of wheat

Different combinations of plant stages were tested in treatments of irrigations.viz. one irrigation (at crown root stage), two irrigations (1st at crown root and 2nd at booting), three irrigations (1st at crown root, 2nd at booting and 3rd at grain filling), three irrigations (1st at crown root, 2nd at booting and 3rd at heading), three irrigations (1st crown root, 2nd at heading and 3rd at grain filling), four irrigations (1st at crown root, 2nd at booting, 3rd at heading and 4th at grain filling) and five irrigations (1st at crown root , 2nd at stem elongation, 3rd at booting, 4th at heading and 5th at grain filling) and

Bio-fortification of wheat through application of Iron and Zinc.

Six treatments with different combinations (soil and foliar application) of Iron and Zinc along with control were tested. Treatments were comprised of Control (No application of

Fe & Zn), Foliar application of 0.5 % ZnSO₄ and Foliar application of 1.0 % Fe SO₄, Foliar application combination of Zn & Fe , Soil application of 10 kg Zn ha⁻¹. Soil application of 12 kg Fe ha⁻¹, Soil application combination of Zn & Fe.

WHEAT ENTOMOLOGICAL STUDIES

Effect of different climatic factors on wheat aphid population.

Experiment was conducted at research area of Wheat Research Institute, Faisalabad during 2018-19. Four Morrieck yellow water tray traps were installed at 200ft distance in 4 different fields at the height of 75cm from ground. Daily alate aphid data was recorded and transformed into weekly basis. The maximum aphid pop was recorded during 3rd week of March, 2019 (191.0) per trap/week having maxi. C^o (27.65) mn. C^o (12.67) and relative humidity 68.5 at 8.00 AM and (41.87) at 5.00 PM. Aphid pop has ve and significant correlation.

Varietal screening of wheat crop against Aphid.

Fourteen wheat varieties/lines were screened out against aphid. Data was recorded from 10 tillers selected and only from each plot of each variety/lines. Data was analyzed with RCBD having three replication.

Lowest aphid pop per tiller was found on variety FSD-08(6.377) followed by V-15166(6.787), V-12304(6.83) and V-15237(6.863), while highest aphid pop. Per tiller was found Hyt-60/S (19.733), followed by Hyt-60-57/(8.577) etc. so satisfactory FSD-08, V-15166, V-12304,

V-15235 etc are at par and least effected by aphid pop. than other wheat varieties/lines.

Screening of wheat germplasm against aphid.

Average aphid pop/tiller on wheat germplasm. Total 465 breeding material/lines were screened out against aphid. The aphid pop remained in the range of Average 1-35 aphids/tiller during wheat season out of 465 varieties/lines 131 varieties/lines has average aphid pop up to 5/tiller and they showed tolerance against aphids. These are least affected by wheat aphids.

Survey of aphid pop on wheat crop in different climate zones of the Punjab.

Aphid survey on wheat crop regarding aphid infestation was conducted in different districts, i.e. Shaiwal, Okara, Pakpattan, Bahawal Nagar, Khanewal, Jhang, Layyah, Bhakkar, Mianwali, Sargodha, Koshab, Mandi Bahoudin, Chinnot, Hafazabad, Gujranwala, Narowal and Sheikhpura etc. Sixty six locations were monitored. Mostly the wheat varieties were FSD-08, PB-11, Ujala-16, ASS-11 and etc No. hot spot was observed. Aphid range was remained 1-15 aphids/tiller on Galaxy-13 and PB-11. So there was no economic loss due to aphid infestation.

WHEAT PATHOLOGY

Investigation on newly emerging foliar diseases of wheat under changing climatic conditions

A survey was conducted in thirty five districts of Punjab for the prevalence/status of newly emerging foliar diseases of wheat particularly wheat blast in different agro ecological zones of Punjab. Total spots visited were two hundred and thirty one. At

Nineteen spots, rust prevalence was above economic threshold level. The traces of rust were observed at one hundred and fifty six spots and no rust prevalence was observed at fifty six field spots.

Disease Trap Nurseries

To monitor the virulence pattern of rust resistant genes as well as for the observation of blast symptoms on foliar part of plant especially head/spike, trap nurseries were planted at eight different locations i.e. Faisalabad, Bahawalpur, Khanewal, Kala Shah Kaku, Kot Naina, Islamabad, Pirsabak and Peshawar. Leaf and yellow rust data was recorded for all these locations.

Screening of Wheat and Barley Advance Lines/Varieties against Rusts at Different Locations

Bread wheat and barley advanced lines were planted at different locations viz. Bahawalpur, Khanewal, Faisalabad, Kala Shah Kaku, Kot Nina, Islamabad, Pirsabak, Fateh Jang and Peshawar against leaf, yellow and stem rusts.

Evaluation of advanced lines/varieties for seedling and adult plant resistance to leaf rust

Sixty four advanced lines of wheat were tested for leaf rust resistance at the seedling stage in green house conditions and in field.

Screening of advanced wheat materials against karnal bunt (*Tilletia indica*)

Two sets of these advanced lines are sown at two different sowing times. 1st set was sown on 15 November 2018 and 2nd set was sown on 15 December 2018.

Survey for karnal bunt and black point of wheat

Grain samples (250 grams each) will be collected from lines of PUWYT and NUWYT throughout the Punjab to find out the prevalence of karnal bunt and black point diseases in different agro ecological zones of Punjab and the analysis will be done in Wheat Pathology Lab.

CEREAL TECHNOLOGY

EFFECT OF LOCAL STORAGE CONDITIONS OF THE PREVIOUS CROP YEARS ON QUALITY AND GERMINATION BEHAVIOR OF CURRENT WHEAT VARIETIES/

LINES

It was observed that as the moisture increased in the same samples during three years storage, their protein content were dropped significantly. Moreover, dry gluten and wet gluten of these samples followed similar pattern. However, when the moisture of the same coded samples kept for three years under local storage conditions dropped, their protein content, dry gluten and wet gluten were raised significantly. Almost all the 22 samples kept under local storage conditions of three years showed similar trend. Moreover, minimum germination % age of 62 was recorded in coded sample No. 25 of first year (2016-17) having 32.55% germination energy (GE) and maximum value of 99% germination was observed in third year (2017-18) coded sample No. 3 possessing 52.43% GE.

QUALITY ASSESSMENT OF COOKIES PRODUCED FROM BLENDS OF WHOLE WHEAT FLOUR AND DIFFERENT FORMS

OF MALTED AND UNMALTED BARLEY FLOURS

Malted barley was prepared by calculating the moisture content of the barley sample used and tempered to a 45 % moisture content. Germination was carried for a week till the acrospires of the grain appears. Drying was done in the Hot air oven at 60 degrees Celsius. Then the dried lot was grind in the lab mill and stored for composite flour production. Unmalted barley flour was made by simple cleaning and grinding of the barley flour and stored for composite flour production. Analysis are in progress.

EFFECT OF GERMINATED BARLEY FLOUR ADDITION ON THE QUALITY OF BISCUITS, CAKES AND BREAD

As the germinated barley flour proportion increased, it reduces protein, gluten content and falling number value while the mineral matter increased significantly. Flour blends rheology revealed that water absorption capacity increased while stability reduced as the barley flour increased. Germinated barley flour addition at 20% level for bread production revealed poor loaf volume, poor crumb and pore structure. 15% barley flour blend biscuits showed product acceptability. Color of the biscuits changed from creamy white to dull brown and the texture became hard at 20% barley flour in wheat flour.

QUALITATIVE ANALYSIS OF WHEAT BREEDING MATERIAL FOR IRON AND ZINC

High Zinc (50-65ppm) lines / varieties were 36, Medium Zinc (38-49ppm) lines/varieties were 83 and Low Zinc (< 37ppm) lines/varieties were 44.

High iron (51.7-74.7ppm) lines / varieties were 87, Medium iron (40.3-40.8ppm) lines/varieties were 57 and Low iron (30.8-35.7ppm) lines/varieties were 29.

ANALYZING THE EFFECT OF DIFFERENT FERTILIZER TREATMENTS ON WHEAT GRAIN QUALITY

The effect of fertilizer combinations and time of their application on physico-chemical quality parameters in advanced wheat lines/varieties for the year 2018-19 are to be tested as soon as the harvested samples arrive.

The harvested samples of the Fertilizer Trials for year 2019 are anticipated for quality analysis.

DETERMINATION OF QUALITY TRAITS IN ADVANCED LINES OF BARLEY

High yielding advanced lines/varieties of barley evaluated for 1000 kernel weight, test weight and protein content, will be compiled as soon as harvested samples are received.

The Barley Trials' harvested samples for year 2019 are awaited for quality analysis.

QUALITY EVALUATION OF BREAD WHEAT ADVANCED LINES/VARIETIES

To screen advanced lines for different quality traits.

Advanced lines included in National Uniform Wheat Yield Trials and Punjab Wheat Yield Trials for the year 2018-19 will be tested for comprehensive quality parameters especially grain weight, test weight, protein, starch, gluten contents and chapatti quality. Samples awaited.

EXTRACTION OF WHEAT GERM OIL FOR THE ASSESSMENT OF VITAMIN E IN THE CURRENT WHEAT VARIETIES/LINES USING HPLC

To assess vitamin E in the current wheat varieties/lines using HPLC.

Grains of three promising varieties will be collected and further be preceded for fractional milling to get germ. After this oil will be extracted from wheat germ and will be processed for the estimation of Vitamin E using standard procedure by HPLC and suitable detector. **Sample awaited**

IMPACT OF SOWING TIME ON PHYTIC ACID, IRON AND ZINC CONTENTS IN WHEAT GRAIN

The trial was planned to determine the variation in iron and Zinc contents due to different sowing time in wheat varieties. Analysis are not yet completed as crop is waiting to be harvested.

PREPARATION OF CHAPATTI FROM ALEURON FLOUR

The trial was planned to get benefits of functional properties of aleuron flour (red dog). Crop is waiting to be harvested so results are not compiled yet.

EFFECT OF PLANTING TIME ON GRAIN QUALITY TRAITS

Trial was designed to study the effect of planting time on grain quality traits. Crop is waiting to be harvested.

EFFECT OF DIFFERENT TEMPERING CONDITIONS ON MILLING YIELD IN RELATION TO DOUGH EXTENSIBILITY

Determination of correlation of flour yield and dough extensibility is the final objective of this trial. Crop is waiting to be harvested.

NUTRITION ENHANCEMENT OF CROPS, FRUITS, VEGETABLES AND THEIR PRODUCTS UNDER CLIMATE CHANGE SCENARIO (c) Flour Fortification and Pasta Production

- Installation of the Pasta Extruder was carried, followed by testing various flour/farina samples to produce standardized pasta products
- Various dyes were tested to produce the most acceptable shaped pasta products
- Farina (*suji*), white flour (maida) and whole meal pasta in form of noodles/spagetti were then cooked according to protocol in fresh and then ambient dry form and their cooking times were calculated for further comparative study.
(Trial Sheets and Evaluation Performa present on record).
- Visual appearance was analyzed concluding pasta made from farina to be the brightest.
(Images available)
- Addition of supplementary ingredients (egg, fat etc.) was being tested at present for taste enhancement
- Previously selected ZnO as a zinc Fortificants will be compared with ZnSO₄ as an additional Fortificants and iron Fortificants NaFeEDTA selected will be compared parallel to FeSO₄ as a supplementary Fortificants. Selection of multiple Fortificants are based on forgoing exploration and literature, physico-chemical effects and economic factors.
(Purchase of salts in progress)

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Publications:

“Nutritive Appraisal of Various Wheat Varieties/Lines for Developing Biofortified Wheat (Triticum Aestivum L.)”. (2018). J Food Process Technol 9(7): 743 Impact Factor = 2.3

“Durum Wheat Pasta: A highly Nutritional Alternate to the Conventional Pakistani Pasta industry” Proceeding accepted (to be published soon) at the 1st Aus-Pak International Conference on Wheat for Food Security held at Muhammad Nawaz Sharif University for Agriculture, Multan (March 24-25, 2019).

“Impact of germinating barley flour addition in wheat flour on quality of

biscuits and bread” Published in Abstract Book, International Conference Week 2019. 1st Aus-Pak International Conference on Wheat for Food Security March 24-25, 2019. Organized by Institute of Plant Breeding and Biotechnology, MNS University of Agriculture, Multan.

“Effects of Climate Changes on Physical and Nutritional Quality of Bread Wheat (Triticum Aestivum)” Accepted for Oral presentation in “1st Aus-Pak International Conference on Wheat for Food Security”, Multan, Pakistan. March 24-25, 2019.

“Assessment of Nutritive Quality and Storage Stability of Cookies Assimilated with Peanut Oil” Abstract accepted for poster presentation (to be published soon) at the International Association for Cereal Science and Technology Conference at Vienna, Austria (April 24-25, 2019).

“Nutritive and Technological Substitute to the Traditional Pakistani Pasta Industry with Durum Wheat Pasta” Abstract accepted as a Poster Presentation for the first International Wheat Congress in Saskatoon, Canada, July 21 – 26, 2019.

“Quantitative Valuation and Qualitative Confirmation of Selective Micronutrients in Bread Wheat Genotypes via Multivariate Scrutiny”. Accepted for Poster presentation in 1st International Wheat Congress in Saskatoon, Canada from July 21-26, 2019.

“Amalgamation of Aleurone Layer in Wheat Flour for the Improvement of End Use Nutritional Quality of Flat Bread” Accepted for Poster presentation in “International Wheat Congress”, Saskatoon, Canada, July 21-26, 2019.

Abdullah, Akbar M, Subhani GM, Ahmad J, Anwar J (2018). Multivariate analysis of some yield and yield related traits of barley (Hordeum vulgare L.) genotypes. Acad. J. Agric. Res. 6(7): 189-197.

Muhammad Zulkiffal*, Aneela Ahsan, Javed Ahmed, Aziz ur Rehman, Muhammad Abdulah, Saima Gulnaz, Muhammad Musa, **Abdullah**, Sadia Ajmal and Muhammad Ijaz (2018). **Appraisal of bread wheat (triticum aestivum l.) genotypes under normal, drought and heat prone environments for morpho-physiological multiplicity and constancy. Int J. Agric. Env. Res. 4(06): 1298-1312.**

Trainings:

Three officers attended local training/workshop (decision support system in agro technology).

One officer attended one month international training entitled “New technology popularizing of agricultural mechanization for developing countries” from Chinese Academy of Agricultural Mechanization Sciences (CAAMS), Beijing, China.

One officer participated in five days local training entitle “Management of natural resources- land, water and forest for sustainable development ” from National Centre for Rural Development, Islamabad.

Two officers participated in two days local training entitled “Emerging technologies in research, advanced MS Office and digital resources” at main library AARI, Faisalabad.

One officer received training entitled “Distinctiveness, uniformity and stability test” at FAO, Lahore.

Two officers participated in five days local training on rabi crops production technology at Regional Agriculture Economic Development Centre, Vehari and advanced analytical techniques for food safety measures in Pakistan” at Nuclear Institute for Agriculture and Biology, Faisalabad, respectively.

Three officers participated in four days local training entitled “Opportunities for gender responsiveness in plant breeding” at International Maize and Wheat Improvement Centre, Islamabad.

Eight officers participated in one day local seminar entitled “Role of plant genetic resources in varietal development and seed system at AARI, Library, Faisalabad.

Three officers of this institute participated in local training course on scientific writing at NIAB, Faisalabad during this month.

Miscellaneous:

One day workshop was conducted on “Wheat quality and its market based classification” at WRI, Faisalabad and one day training on ‘wheat production

technology’ for the master trainers of agriculture extension wing from all over Punjab.

All concerned officers of Wheat Research Institute, Faisalabad participated in election duty 2018.

Dr. Javed Ahmed, Director Wheat Research Institute, Faisalabad, delivered lecture on wheat production technology at farmer days at Sumondri.

Dr. Javed Ahmed, Director Wheat Research Institute, Faisalabad, attended FAO meeting on wheat marketing at Lahore.

Dr. Javed Ahmed, Director Wheat Research Institute, Faisalabad, inspected fertilizer marketing unit, Faisalabad.

Wheat advanced line (V-12304) has been recommended by experts sub committee for consideration of its approval by Punjab Seed Council.

The final variety cases of one wheat advanced line (V-12304) and two lines of barley (B-09006 and B-09008) have been submitted to Punjab Seed Council for final approval.

Fourteen abstracts were written and submitted for 1st Aus-Pak international Conference on Wheat for Food Security at Muhammad Nawaz Sharif University of Agriculture, Multan.

One day training was arranged on wheat rusts and blast diseases. About 80 master trainers of agriculture extension and pest warning and quality control officers participated.

Dr. Karanjeet Singh and Dr. Darinder Singh from University of Sydney, Australia, Additional Secretary, Task Force, DG, Pest Warning and Quality Control, DG, Agric Extension, Punjab visited Wheat Research Institute, Faisalabad and they were briefed about research activities at farm and also visited cereal technology laboratories.

Sixty students from different universities are doing internship under the supervision of WRI, Faisalabad's scientists.

Wheat rust surveillance was conducted to observe rust existence and wheat crop condition. The activity was conducted in 96 different locations of Punjab districts.

Dr. Harpinder Singh Randhawa, (Agriculture and Agri-Food Canada, Lethbridge, Canada) visited Wheat Research Institute, Faisalabad and they were briefed about research activities at farm and also visited cereal technology laboratories.

A lecture and practical demonstration was delivered by Mr. Awais Rasheed (Adjunct scientist from CIMMYT-China-Turkey) on use of drone technology for phenotyping in wheat under climate change scenario.

A farmer day was organized at village # 293/R.B. Tehsil Chak Jhumra, District Faisalabad to promote wheat planting with Zero Tillage (happy seeder). Dr. Javed Ahmed, Director Wheat Research Institute, Faisalabad, highlighted the current crop situation and its management in relation to prevailing

weather conditions and answered different questioned raised by farming community.

Travelling Wheat Seminar with concluding session was conducted at Wheat Research Institute, Faisalabad.