AGRONOMIC RESEARCH INSTITUTE, FAISALABAD

Dr. Muhammad Musa
Chief Scientist
Tel: +92-41-9201676
Cell: +92-306-6782882
Email: darifsd84@gmail.com

OVERVIEW

Agronomy is generally referred to as the mother of agricultural sciences. In the scenario of burgeoning increase in population, its role in abridging the gap between food demand and supply is of pivotal importance. Agronomic Research Institute, Faisalabad was established in 1984 in order to cater the agricultural research needs of Punjab Province. Keeping in view the climatic variations, different sections and stations of this institute were set up in different agro-ecological zones of the province viz. Faisalabad, Farooqabad (Sheikhupura), Bahawalpur, Pakpattan, Khanewal and Karor (Layyah). The main focus of this institute is to develop and standardize the crop production technologies and to revisit the existing crop production plans in the context of changing climate. Integrated weed management, optimizing time and methods of water and fertilizer application, crop diversification through introduction of new and high value crops, production and multiplication of basic and certified seed of different crops are some other areas of research focus of this institute. The production technologies developed by this institute have not only improved per acre yield of different field crops but also raised the living standard of the farming community. The current threat of abrupt climate change has called for revisiting the crop production technologies. Strenuous efforts are being made to develop new production technologies containing the solutions of the growers in relation to climate change.

Experiments were conducted to assess the impact of climate variability on seed cotton yield and to test the seed health of different pickings of different sowing times. Results revealed that early sowing of cotton crop produces higher seed cotton yield. Study was conducted to find out the best combination of green manuring crops and nitrogen doses for better yield of rice. The best result was found where Sesbania with 125 % of the recommended nitrogen was applied. Maize hybrids were evaluated for their better heat tolerance by planting them at three dates. Mid February sown hybrid gave the maximum yield. A field study was designed during Kharif season 2021 with an objective to find out optimum sowing time of mungbean varieties for higher grain production and highest grain yield was obtained from AZRI moong 2018. Study was conducted to find out best suited strains of Zaid Kharif Brassica for Thal irrigated area and ZBJ-17019 gave maximum seed yield of 2917 kg ha^{-1}. An experiment was conducted to improve emergence, growth and yield of wheat by increasing water retaining capacity of soil. It was concluded that 5 Kg ha^{-1} hydrogel may be applied before sowing to not only get higher yield as well as to save water.

A PARB Funded project focusing on bio fortification of crops is in progress and another PARB Project on “Developing Agricultural Waste Management System to Produce Different Kinds of Organic Fertilizers for Sustainable Agriculture” is also in progress. An ADP project on Research and Promotion of Medicinal Plants is completed which different medicinal plants such as Ajwain, Saunf, Isabgol etc. were grown and tested at different locations across Punjab. Results of the research work carried out during Kharif 2021 and Rabi 2021-22 are elaborated briefly as under:

COTTON

ASSESSING CLIMATIC RISKS TO COTTON LINT AND SEED PRODUCTION BY IMPOSING DIFFERENT TEMPERATURES IN THE FIELD SETTING

This study was conducted to assess the impact of climate variability on seed cotton yield and to test the seed health of different pickings of different sowing times. Experimental treatments were comprised eight sowing dates, 1st , 16th March, 1st April, 16th April, 1st May, 16th May, 1st June and 16th June. Cotton variety MNH-1026 was used as test variety in this experiment. Results of this study showed the gradual reduction in seed cotton yield as crop sown from 1st to 16th June. No significant difference was recorded in plant population of the crop sown from 1st March to 16th May, whereas crop sown on 1st June and 16th June resulted in less plant population (Table 1). Maximum plant height was recorded when crop was sown during 1st March (150 cm) and 16th March (162 cm). Whereas delay in sowing of cotton caused gradual reduction in plant height (Figure 2). However crop sown from 1st March to 16th April resulted in higher number of monopodial branches as compared to crop sown after 16th April. However higher number of sympodial branches (36) were recorded when cotton was sown on 1st March. Higher number of bolls per plant was recorded in crop sown on 16th March (46) that were statistically at par with the number of bolls of the crop sown on 1st March (38). Whereas increase in temperature during growing period caused considerable reduction in number of bolls per plant (Figure 4). However higher average boll weight was recorded from the crop sown on 16th June (4.0 g) that was statistically at par with the average boll weight of crop sown on 1st June (3.53 g) and the average boll weight was gradually increased with reduction in plant population (Figure 5). Moreover higher seed cotton yield (2319 kg ha^{-1}) was recorded when crop was sown on 1st March (Table 1) and reduction in seed cotton yield was recorded owing to increase in temperature during growing period. Regarding quality parameters, higher GOT was recorded in crop sowing on 1st June, whereas higher staple length and mike were recorded in crop sown during 1st and 16th April and higher staple strength was recorded in crop sown during 16th May (Figure 1). However regarding seed related parameters, higher number of normal seedlings was recorded when cotton was sown on 16th March and no abnormal seedlings was recorded when cotton was sown on 1st May (Figure 1). Hence it can be concluded that early sowing of cotton crop results in higher seed cotton yield.

Table 1: Effect of planting time on yield and yield components of cotton crop

Sowing dates	Plant population at maturity (ha^{-1})	Plant height (cm)	Monopodial branches per plant	Sympodial branches per plant	Bolls per plant	Average boll weight (g)	Yield (kg ha^{-1})	Increase/decrease (%)
1st March (~24°C/11 °C)	43333 A	162 A	2 A	36 A	46 AB	2.27 D	2319 A	256
16th March (~27°C/15 °C)	40000 A	150 A	2 A	32 B	38 A	2.43 C	2277 B	243
1st April (~30°C/15 °C)	36667 A	135 B	2 A	29 C	34 BC	2.70 C	2037 C	213
16th April (~35°C/18 °C)	33333 A	121 C	2 A	20 D	26 C	2.77 C	1239 D	91
1st May (recommended) (~36°C/20 °C)	33333 A	105 D	1 B	12 E	15 D	3.13 C	668 E	-
16th May (~38°C/21 °C)	30000 A	92 D	1 B	7 F	11 D	3.27 BC	427 F	-32
1st June (~35°C/22 °C)	20000 B	70 E	1 B	5 F	8 DE	3.53 AB	102 G	-80
16th June (~40°C/25 °C)	16667 B	41 F	1 B	2 G	2 E	4.00 A	41 H	-91
LSD α 0.05	17668	14	1.4	3.2	8	0.51	48	

Means sharing same case letter do not differ significantly at p≤0.5

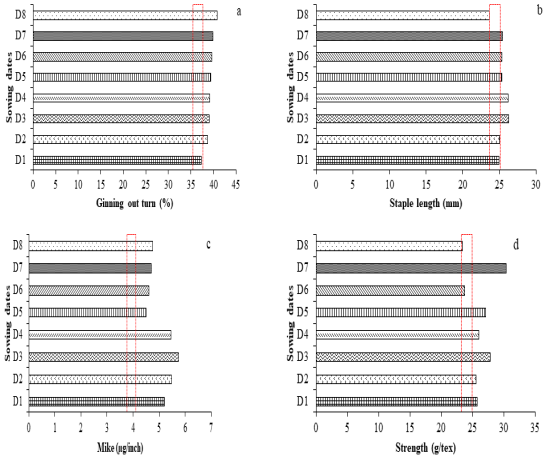

Figure 1: Effect of planting time on cotton quality parameters

a= ginning out turn; b= staple length; c= mike; d= strength; D1= 1st March; D2= 16th March; D3= 1st April; D4= 16th April; D5= 1st May; D6= 16th ; D7= 1st June; D8= 16th June

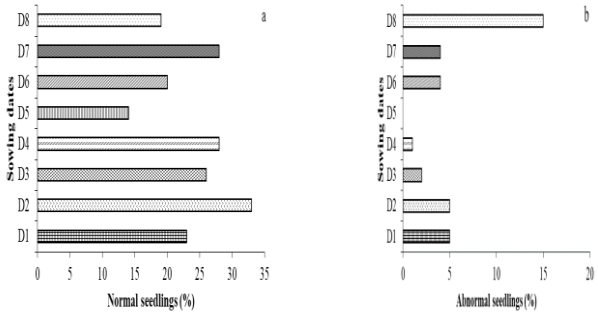

Figure 2: Effect of planting time on cotton seed related parameters

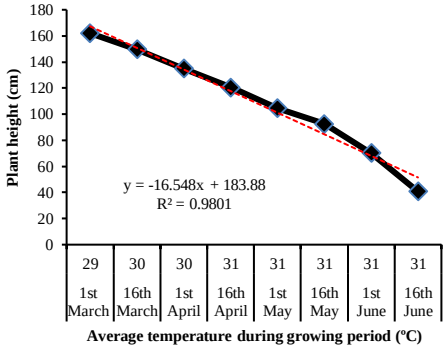

Figure 3: Effect of temperature during growing period on plant height (cm) of cotton

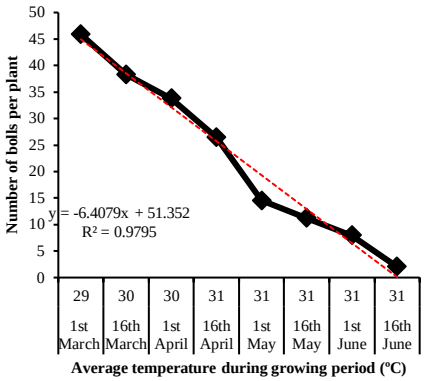

Figure 4: Effect of temperature during growing period on number of bolls per plant of cotton

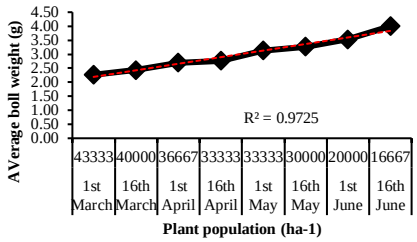

Figure 5: Effect of plant population of each sowing date on average boll weight (g) of cotton

Difference in growth between sowing of cotton at 1st March and 1st June

RICE

RESPONSE OF RICE TO DIFFERENT GREEN MANURING CROPS AND NITROGEN FERTILZER DOSES

To find out the best combination of green manuring crops and nitrogen doses for better yield of rice, an experiment was conducted at Agronomic Research Station Farooqabad.

Experiment consists of following two factors

A. Green manuring crops: Mung bean, Sesbenia and No Green Manuring

B. Nitrogen doses: Recommended dose of nitrogen (142 kg.ha^{-1}), 75 % of the recommended nitrogen (106.5 kg.ha^{-1}),
Half dose of recommended nitrogen (71 kg.ha^{-1}) and 125 % of the recommended nitrogen (177.5 kg.ha^{-1})

Table.2: Paddy yield Kg ha^{-1}

	Mung bean	**Sesbenia**	**Guar**	**Means**
Half dose of recommended nitrogen	2200 ef	2500 de	1933 f	2211 c
75 % of the recommended nitrogen	3267 c	3633 bc	2267 ef	3056 b
Recommended dose of nitrogen (142 kgha^{-1})	3800 ab	4033 a	2833 d	3556 d
125 % the of recommended nitrogen	4000 ab	4167 a	3633 bc	3933 a
Means	3317 b	3583 a	2667 a	

LSD value for Green manuring = 191.73
LSD value for Nitrogen doses = 211.17
LSD value for interaction= 367.82

According to data maximum paddy yield (4167) kg ha^{-1} was obtained from the treatment where Sesbenia with 125 % of the recommended nitrogen was applied.

COMPARATIVE PERFORMANCE OF RICE (*ORYZA SATIVA* L.) CULTIVARS UNDER TERMINAL HEAT STRESS

Endurance of terminal heat stress in five rice varieties (Punjab basmati, Chenab basmati, kissan basmati, PK-1121 aromatic & super gold) was tested for their performance by sowing on three dates (5th May, 20th May & 5th June). All the rice varieties gave significantly the maximum seed yield (4.49, 4.73, 4.79, 4.91 & 5.02 t/ha for kissan basmati, chenab basmati, PK-1121 aromatic, super gold & Punjab basmati respectively) when sown on 20th May. The rice varieties sown on 5th May produced the least seed yield while the sowing date of 20th June ranked in this regard. Among the rice varieties the data depicted that super gold remained the best by producing seed yield of 4.24 t/ha whereas the variety chenab basmati remained at the bottom with the seed yield of 3.9 t/ha **(Fig. 6)**.

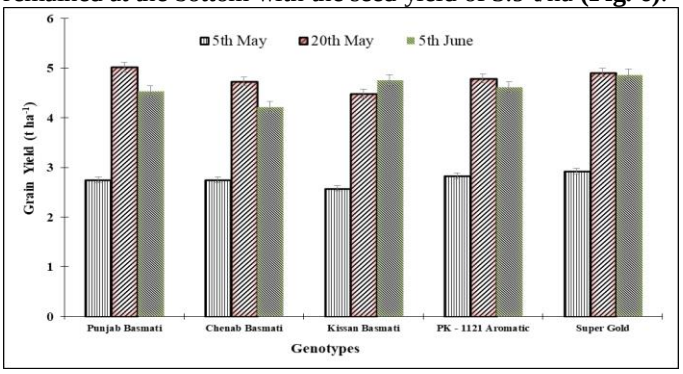

Fig 6: Effect of heat stress on grain yield (kg/ha) of rice

Fig 7: Pictorial view of rice cultivars under terminal heat stress

MAIZE

COMPARATIVE PERFORMANCE OF SPRING HYBRIDS OF MAIZE UNDER TERMINAL HEAT STRESS

Four maize hybrids (YH-5427, YH-1898, FH-1046 & NK-8441) were evaluated for their better heat tolerance by planting them at three dates (15th February, first & 15th March) as adaptation mechanism under changing climate. The maize hybrid YH-5427 sown at 15th February performed significantly the best and gave maximum grain yield of 10.1 t/ha **(Fig. 8)**.

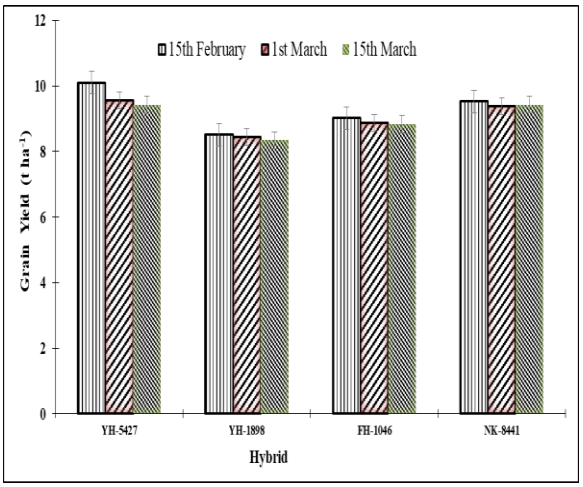

Fig 8: Effect of terminal heat stress on grain yield (kg/ha) of maize

MUNG BEAN

OPTIMIZING PLANTING TIME OF MUNGBEAN VARIETIES FOR HIGHER GRAIN YIELD

Planting date plays important role in the growth, development and yield of a crop. Optimum planting time has becomes a prime importance for higher crop production, as well as pest and disease management. Keeping in view a field study was designed during Kharif season 2021 with an objective to find out optimum sowing time of mungbean varieties for higher grain production. Four genotypes of mungbean (NIAB MOONG 2016, NIAB MOONG 2021, AZRI MOONG 2018 and AZRI MOONG 2021) were placed in main plots while different five planting times (15th of March to 15th of May with 15 days interval) were kept in subplots. The experiment was laid out in RCBD with split plot arrangement with having three replications. Fertilizer at the rate of 23-60-00 NPK kg ha^{-1} respectively were applied at the time of sowing. Line sowing through hand drill was done keeping row to row spacing of 30 cm. All other agronomic practices were kept normal and uniform. The data illustrated that there mungbean crop produced higher grain yield of 893 kg ha^{-1} when planed on 1st April. The lowest grain yield 536 kg ha^{-1} was attained by crop was sown on 15th of May. Among varieties highest grain yield was obtained from AZRI moong 2018.

As for as interaction is concerned the higher grain (993kg ha^{-1}) was produced by mungbean variety AZRI-2018 when planted on 1st April. The mungbean variety AZRI-2021 produced minimum grain yield of 479 kg ha^{-1} when sown on 15th of May, 2021

CANOLA

MICRO SEED YIELD TRIAL ZAID KHARIF BRASSICA (*B. juncea*), 2020-21

The trial was conducted with a view to find out best suited strains of Zaid Kharif Brassica for Thal irrigated area, in collaboration with Oilseeds Research Institute, Faisalabad. Five strains of Zaid Kharif Brassica were sown on 17th of September at Agronomic Research Station Karor, during Rabi, 2021-22. The layout was Randomized Complete Block Design with three replications having net plot size 1.8m × 5m. The row and plant spacing were kept 45 cm and 15 cm respectively. A uniform N-P-K dose of 80-60-60 kg ha^{-1} was applied. All P and K and 1/3rd of N were applied as basal dose while the remaining 2/3rd of N was applied in two equal splits at flowering and pod formation stage. The experiment was sown through hand drill and plant to plant distance was maintained after thinning. All other agronomic and plant protection practices were kept uniform.

The data showed that the strain ZBJ-17019 gave maximum seed yield of 2917 kg ha^{-1} followed by ZBJ-17008 which produced grain yield of 2222 kg ha^{-1}. The Minimum seed yield of 1484 kg ha^{-1} was received from ZBJ-19008.

WHEAT

EFFECT OF DIFFERENT SOIL AMENDMENTS ON SOIL MOISTURE RETENTION AND WHEAT YIELD

This experiment was conducted to improve emergence, growth and yield of wheat by increasing water retaining capacity of soil. Experiment was comprised of seven treatments including application of various soil amendments i.e. control (no amendment), hydrogel @ 5 kg ha^{-1}, gypsum @ 5 t ha^{-1}, FYM @ 10 t ha^{-1}, compost @ 1 t ha^{-1}, straw mulch @ 2 t ha^{-1}, biochar @ 5 t ha^{-1}. These amendments were applied at the time of seed bed preparation. Higher water holding capacity was recorded in the treatment where hydrogel was applied as well as in the treatment where FYM was applied (Figure 9). Less amount of water was required to irrigate the plots which were treated with hydrogel followed by the treatment where FYM was applied (Figure 10). Higher productive tillers (299 m^{-2}) were recorded in the treatment where hydrogel was applied followed by the treatment where FYM was applied (270 m^{-2}). Likewise longer spike (12 cm) were recorded in the treatment where hydrogel was applied that was statistically at par with treatments where FYM (11 cm), compost (11 cm), straw mulch (11 cm) and biochar (11 cm) were applied (Table 3). Moreover higher grains per spike were also recorded in the treatment where hydrogel was applied (35) that was statistically at par with treatments where FYM (32) and straw mulch (32) were applied (Table 3). Bolder grains were recorded in the treatments where hydrogel (69 g) and FYM (64 g) were applied that were statistically at par with treatment where straw mulch (59 g) was applied (Table 3). Similarly higher grain yield was recorded in the treatment where hydrogel was applied (5624 Kg ha^{-1}) that was statistically at par with the treatment where FYM (5544 Kg ha^{-1}) was applied (Table 4). Higher cost benefit ratio (1:1.85) was also recorded in the treatment where hydrogel was applied and the treatment where FYM was applied (1:1.80). Hence it can be concluded that 5 Kg ha^{-1} may be applied before sowing to not only get higher yield as well as to save water.

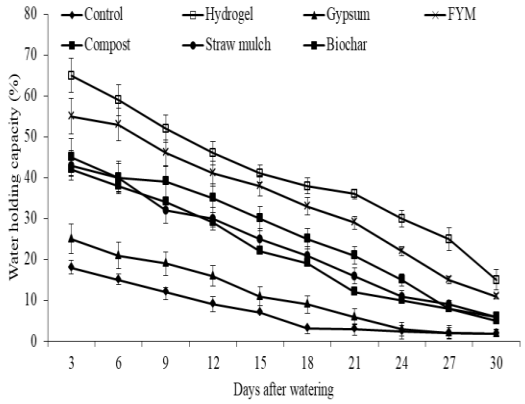

Figure 9: Water holding capacity of each treatment

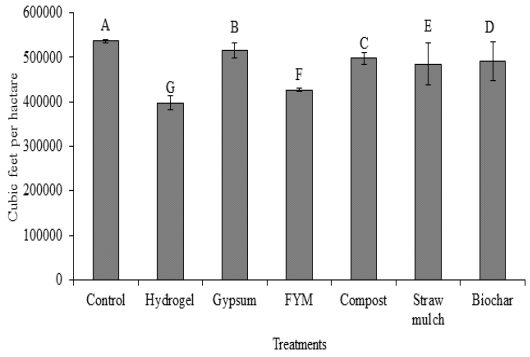

Figure 10: Amount of water applied to each treatment from sowing to harvesting

Table 3: Effect of various soil amendments on yield and yield components of wheat

Treatments	Plant height (cm)	Productive tillers (m^{-2})	Spike length (cm)	Spikelets per spike	Grains per spike	1000-grains weight (g)	Grain yield (Kg ha^{-1})
Control (no amendment)	82	153E	9C	16	21D	35C	2133CD
Hydrogel 5 kg ha^{-1}	79	299A	12A	17	35A	69A	5624A
Gypsum 5 t ha^{-1}	83	210D	11BC	17	24CD	40C	2025D
FYM 10 t ha^{-1}	74	270AB	11AB	16	32AB	64A	5544AB
Compost 1 t ha^{-1}	74	227CD	11AB	16	25CD	44BC	2529CD
Straw mulch 2 t ha^{-1}	80	248BC	11AB	16	32AB	59AB	4580B
Biochar 5 t ha^{-1}	78	247BC	11AB	16	29BC	45BC	3054C
LSD α 0.05		35.74	1.11		5.55	15.06	993.35

Table 4: Economic analysis of various soil amendments applied to wheat

Treatments	Cost of production (Rs./ha)	Gross income (Rs./ha)	Net income (Rs./ha)	Cost benefit ratio (CBR)
Control (no amendment)	164669	172315	7646	1:1.05
Hydrogel 5 kg ha^{-1}	167169	309320	142151	1:1.85
Gypsum 5 t ha^{-1}	179669	166375	-13294	1:0.93
FYM 10 t ha^{-1}	169669	304920	135251	1:1.80
Compost 1 t ha^{-1}	174669	194095	19426	1:1.11
Straw mulch 2 t ha^{-1}	165669	252450	86781	1:1.52
Biochar 5 t ha^{-1}	172669	222970	50301	1:1.29

Application of various soil amendments to study their effect on water use efficiency

YIELD PERFORMANCE OF PROMISING WHEAT VARIETIES UNDER NORMAL AND LATE SOWN CONDITION IN RICE-WHEAT CROPPING SYSTEM

To find out the best variety of wheat for normal and late sown in rice-wheat cropping system, an experiment was conducted at Agronomic Research Station Farooqabad.

Experiment was consisted of two factors

A. Sowing Time

1. 1st week of November
2. 1st week of December

B. Wheat Varieties

1. Akbar-2019
2. Ghazi
3. Anaj-2017
4. Ujala-2016
5. Galaxy-2013
6. Punjab-2011
7. Faisalabad-2008

Table. 5: Wheat yield Kg ha^{-1}

Variety	1st week of November	1st week of December	Means
Akbar-2019	4283 a	4017 abc	**4150 A**
Ghazi	4200 ab	3850 bcde	**4025 A**
Anaj-2017	3333 fg	3783 cde	**3558 BC**
Ujala-2016	3733 cde	3333 fg	**3533 BC**
Galaxy-2013	3650 def	3216 g	**3433 C**
Punjab-2011	3633 def	3750 cde	**3691 B**
Faisalabad-2008	3950 abcd	3567 efg	**3758 B**
Means	**3826 A**	**3645 B**	

LSD for SD*V= 361.23, LSD for SD = 161.00, LSD for V= 254.72

According to data maximum wheat yield (4283kg ha^{-1}) was obtained from the treatment where wheat variety Akbar-2019 was sown in 1st week of November.

Yield performance of promising wheat varieties under normal and late sown condition in rice-wheat cropping system

INFLUENCE OF SEED TREATMENTS ON PERFORMANCE OF WHEAT IN CONVENTIONAL AND CONSERVATION SOWING

Two sowing methods (conventional sowing & conservation tillage) and four seed treatments (Control, Soil application of ZnSO4 @ 15 kg/ha, Seed coating by ZnSO4 @ 1.25g / kg seed & seed priming by 0.3% ZnSO4 solution for 16 hours) were studied to determine their effect on wheat crop stand and subsequently on yield. Seed primed with 0.3% ZnSO4 solution produced the highest grain yields for both sowing methods (5.31 t/ha for conventional sowing and 4.97 t/ha for conservation tillage). Whereas rest of the treatments were at the lowest ebb in this regard **(Fig. 11)**.

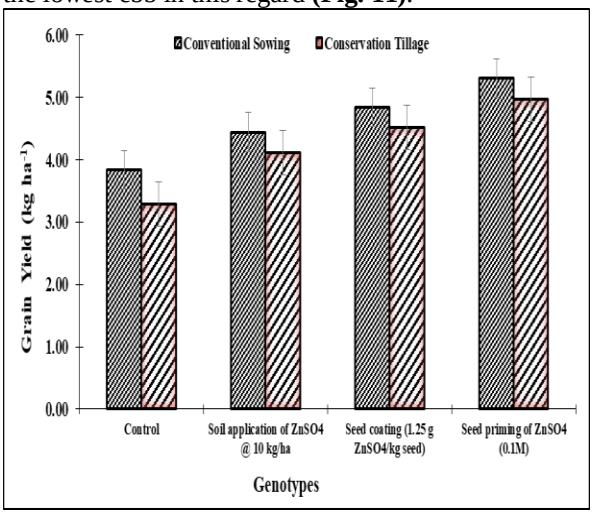

Fig 11: Effect of sowing method and seed treatments on wheat grain yield (t ha^{-1})

SCREENING AND EVALUATION OF MEDICINAL PLANTS

TULSI

SCREENING AND EVALUATION OF TULSI (*OCIMUM TENUIFLORUM*) GERMPLASM *OCIMUM TENUIFLORUM*

commonly known as ***tulsi***, is an aromatic perennial plant in the family Lamiaceae. Tulsi is cultivated for religious and traditional medicine purposes and also for its essential oil. A trial was laid out in RCBD having three replications with plot size of 1.8 m × 5.0 m. Tulsi was sown on ridges (R× R=75 cm). Fertilizer @ 60-60 NP kg ha^{-1} was applied at the time of sowing. All other agronomic practices were kept normal and uniform during the course of study. Out of ten Tulsi genotypes studied in the duration under report four produced the best results for their yield. The genotypes- 7 produced significantly maximum seed yield of 2390 kg ha-1 and was followed by the genotype-1 (2142 kg ha^{-1}) while the genotype-6 produced the lowest yield (828 kg ha^{-1}) as shown in the **Fig 12**. The best performing four genotypes were selected for sowing in future.

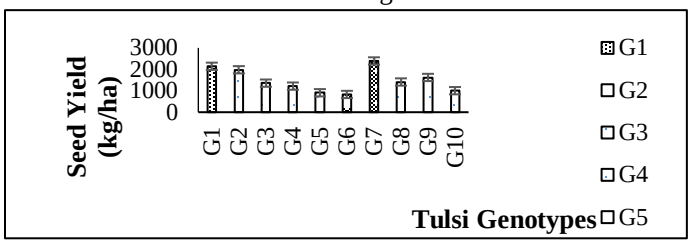

Fig 12: Seed yield (kg ha^{-1}) of different genotypes of Tulsi

Fig 13 (a-b): Pictorial view of different genotypes of Tulsi at maturity

NIGELLA

STANDARDIZATION OF PLANTING TIME AND SEED RATE OF KALONJI (*NIGELLA SATIVA*)

This field study was conducted to acclimatize and standardize the planting time and seeds rate for Kalonji cultivation. The experiment was comprised of 2 factors i.e. planting time (15th October, 1st November and 15th November) and seed rate (6,7 and 8 kg ha^{-1}). The treatments were laid out in field following split plot design keeping sowing dates in main plots while seed rate in sub plot with three replications. Higher number of plants (m^{-2}) were recorded when Kalonji was sown on 1st November (19.56), in addition to that higher number of plants (m^{-2}) (19.89) were recorded when Kalonji seed rate 8 kg ha^{-1} was used (Table 6). Similarly taller plants were recorded when Kalonji was sown on 1st November (98.22 cm) (Table 6). Nonetheless increase in seed rate resulted in reduction in number of branches per plant hence higher number of branches (5.56) were recorded when 6 kg ha^{-1} seed rate was used (Table 6). Regarding capsules per plant (20.56), seeds per capsule (84.11) and 1000-grains weight (3.09 g), higher were recorded when Kalonji was sown on 1st November (Table 6). Higher Kalonji grain yield (1177.30 Kg ha^{-1}) was recorded when Kalonji was sown on 1st November with seed rate 7 kg ha^{-1} was used (Table 6).

Table 6: Yield and yield components of Kalonji affected by various sowing dates and seed rates

Treatments	Number of plants (m^2)	Plant height (cm)	Branches per plant	Capsules per plant	Seeds per capsule	1000-grain weight (g)	Grain yield (Kg ha^{-1})
Sowing dates (D)							
15th October (D_1)	17.33B	73.22B	4.56	18.33B	72.78B	2.63B	607.70B
1st November (D_2)	19.56A	98.22A	4.67	20.56A	84.11A	3.09A	1054.9A
15th November (D_3)	17.22B	73.56B	4.67	12.22C	67.11C	2.75B	370.60C
LSD p 0.05	0.78	1.57	-	0.59	3.57	0.20	68.43
Seed Rate (S)							
6 kg ha^{-1} (S_1)	16.00C	78.67	5.56A	19.22A	74.22	2.76	655.00B
7 kg ha^{-1} (S_2)	18.22B	80.67	4.78B	17.89B	74.11	2.86	744.89A
8 kg ha^{-1} (S_3)	19.89A	80.67	3.56C	14.00C	75.67	2.86	633.22B
LSD p 0.05	0.61	-	-	0.78	-	-	55.70
D×S							
$D_1 \times S_1$	15.33	72.00	5.33	21.00b	75.33	2.53	615.30c
$D_1 \times S_2$	17.33	72.33	5.00	18.00c	70.33	2.70	599.30c
$D_1 \times S_3$	19.33	75.33	3.33	16.00d	72.67	2.67	608.30c
$D_2 \times S_1$	17.33	91.67	5.67	22.67a	82.00	2.97	999.00b
$D_2 \times S_2$	19.67	93.67	4.67	21.67ab	86.33	3.17	1177.30a
$D_2 \times S_3$	21.67	94.33	3.67	17.33c	84.00	3.13	899.30b
$D_3 \times S_1$	15.33	72.33	5.67	14.00e	65.33	2.77	350.70e
$D_3 \times S_2$	17.67	76.00	4.67	14.00e	65.67	2.70	458.00d
$D_3 \times S_3$	18.67	72.33	3.67	8.67s	70.33	2.78	303.00e
LSD p 0.05	-	-	-	1.35	-	-	96.48

Means sharing same case letters do not differ significantly at p≤0.05

Standardization of planting time and seed rate of kalonji (*nigella sativa*)

SCREENING AND EVALUATION OF LINSEED (*LINUM USITATISSIMUM*) GERMPLASM

The experiment was conducted with objective to screen and evaluate the performance of 12 locally acquired linseed genotypes / germplasm. Crop was sown on beds having row to row distance of 75 cm. the genotype LS-12 and LS-10 produced significantly the maximum seed yield of 1853.7 and 1852.8 kg/ha, respectively and were followed very closely by the genotype LS-01 **(Fig. 14)**.

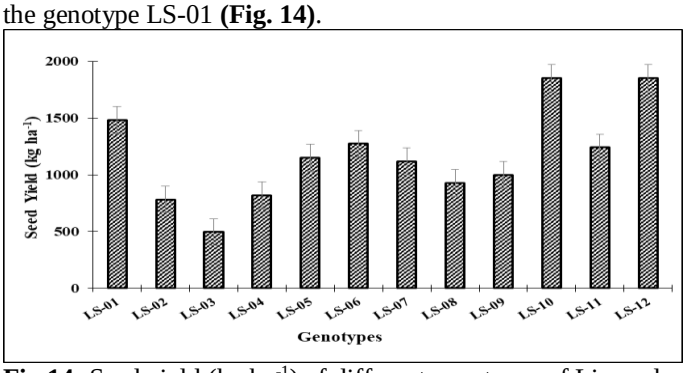

Fig 14: Seed yield (kg ha^{-1}) of different genotypes of Linseed

ON-GOING PROJECTS

PARB PROJECT-904

Nutrition enhancement of crops, fruits, vegetables and their products under climate change scenario.

PARB Project on "Developing Agricultural Waste Management System to Produce Different Kinds of Organic Fertilizers for Sustainable Agriculture"

MISCELLANEOUS ACTIVITIES

Publications:	42
Urdu/English articles:	11
Radio talks:	34
Seminars attended/delivered:	60
Internee supervised:	44
Class visits:	10
Capacity building:	19
Farmer days conducted:	3
Varieties Approved:	0
Production of Stevia Plants:	16319
Seed germination tested:	354

	Title	Author Name	Year	Experiment	Journal Name (complete)	Page No.	Volume No.
Research Paper	Understanding the agricultural systems modeling; A review	Ahmad,A. Shehzadi, M. Wajid ,A,S. Ghafoor,J,M ,R. Akhtar, N. Shafqat,M. Mahreen,N. and Sher,R.	2021	-	International journal of advanced trends in computer science and engineering.	2241-2248	10(3)
	Influence Of Innovative Sowing Mehods On Yield And Economics Of Wheat (*Triticum Aestivum*) In Rice -Wheat Cropping System	Mehmmod, A., Shehzadi, M., Khaliq, A., Shafqat, M. Sher, R., M., Munir, K.M., Younus, M. and Afzal, S.M.	2021	-	Journal of Agricultural Research.	151-155	59(2)
	Drought tolerance in rice and role of WRKY genes	Kanwal, S. Jamil, S. Afza. N. Gafoor, I. Shehzadi, M. Kanwal, R and M.Z. Iqbal.	2022	-	Journal of Animal and Plant Sciences.	615-630	32(3)
	Simulating the growth and yield of peanut cultivars under temporal variation using cropgro-peanut (DSSAT) model	Adeel, A. Wajid, A. Saleem, H.M. shehzadi, M. Rehan, M. Hussaan, M. Faheem, M. Javed, T.M. El-Sheikh, A.M. Alshaya,H and Ali, S.	2022	-	Pakistan Journal of Botany	1-8	54(3)
	Legume-rhizobiz symbiosis under abiotic constraints: performance system	Abdi, N., M. Labuschange, **A. Ullah**, I. Hemissi, A.V. Biljon, A. Hachana and B. Sifi	2021	-	Agrocienica	37-61	55
	Effect of Temperature on Sowing Dates of Wheat under Arid and Semi-arid Climatic Regions and Impact Quantification of Climate Change through Mechanistic Modeling with Evidence from Field	Hussain, J., T. Khaliq, M. H. Rahman, A. Ullah, I. Ahmed, A. K. Srivastava, T. Gaiser and A. Ahmad	2021	-	Atmosphere	1-16	12
	Boron biofortification through seed coating: a way to alleviate malnutrition and to improve grain yield of bread wheat	Iqbal, S., M. Farooq, A.Ullah, M. Luqman, H.M. Akram, M. K. Munir and N. Zafar	2021	-	Pakistan Journal of Agricultural Sciences	1501-1509	58
	Improving water use efficiency through various planting techniques in winter Wheat (*Triticum aestivum* L.)	Iqbal, S., A. Ullah, M. Luqman, H. M. Akram, M. K. Munir and N. Zafar	2022	Comparison of sowing methods for saving water and improving productivity of wheat	Sarhad Journal of Agriculture	470-479	38
	Influence of foliage applied boron on yield and related traits of bread wheat (*Triticum aestivum* L.)	Iqbal, S., M. Farooq, A.Ullah, M. Luqman, A. Malik, M. K. Munir and N. Zafar	2022	-	Egyptian Journal of Agronomy	11-18	44
	Enhancing the	Zulfiqar, U.,	2021		Crop &	32-43	73

	accumulation and bioavailability of iron in rice grains via agronomic interventions	S. Hussain, M. Maqsood, S.I. Zamir, M. Ishfaq, N. Ali, M. Ahmad and M.F. Maqsood			Pasture Science.		
	Cadmium Toxicity in Plants: Recent Progress on Morpho-physiological Effects and Remediation Strategies	Zulfiqar, U., A. Ayub, S. Hussain, E.A. Waraich, M.A. El-Esawi, M. Ishfaq, M. Ahmad, N. Ali and M.F. Maqsood	2022		Journal of Soil Science and Plant Nutrition	212-269	22
	Economic assessment of water-saving irrigation management techniques and continuous flooded irrigation in different rice production systems	Ishfaq, M., N. Akbar, U. Zulfiqar, N. Ali, F. Shah, S.A. Anjum and M. Farooq	2022		Paddy and Water Environment	37-50	20
	Cadmium phytotoxicity, tolerance and advanced remediation approaches in agricultural soils; a comprehensive review	Zulfiqar, U., W. Jiang, W. Xiukang, S. Husain, M. Ahmad, M.F. Maqsood, N. Ali, M. Ishfaq, M. Kaleem, F.U. Haider, N. Farooq, M. Naveed, J. Kucerik, M. Brtnicky and A. Mustaf	2022		Frontiers in Plant Science	773815	13
	Appropriate fodder last cut date to enhance forage, seed production and benefit cost ratio of alfalfa crop	Gondal, M.R., M. Arshad, W. Naseem, M.S.A. Bazmi, A. Shah, N. Ali, A. Khaliq, I. Haider, M. Arif	2022		Journal of Economic Impact	116-121	4
	Impact of different water management Regimes on the growth, productivity, and resource use efficiency of dry direct seeded rice in Central Punjab-Pakistan	Hussain, S., S. Hussain, Z. Aslam, **M. Rafiq**, A. Ali, M. Saqib, A. Rauf, C. Hano and M.A. El-Esawi	2021		Agronomy	1151	11
	Seed priming with sorghum water extract improves the performance of Camelina (*Camelina sativa* (L.) Crantz.) under salt stress	Huang, P., L. He, A. Abbas, S. Hussain, S. Hussain, D. Du, M.B. Hafeez, S. Balooch, N. Zahra, X. Ren, **M. Rafiq** and M. Saqib	2021		Plants	749	10
	Characterization of environmental conditions conducive for leaf rust and genetic diversity on wheat crosses based upon Physiomorphic traits	Ali, Y., A. Khan, A. Ijaz, M.H. Atif, A. Rahim, S. Ahmad, D. Sabir, S. Naseer and **M. Rafiq**	2021		Pakistan Journal of Phytopathology	125-136	33
	Screening of wheat (*Triticum aestivum* L.) genotypes for drought tolerance through Agronomic and Physiological response	Ahmad , A., Z. Aslam, T. Javed, S. Hussain , A. Raza, R. Shabbir , F. Mora-Poblete, T. Saeed, F. Zulfiqar, M. M. Ali , M. Nawaz, **M. Rafiq**, H. S. Osman, M. Albaqami, M. A. A. Ahmed & M.Tauseef	2022		*Agronomy*	287	12
	Influence of salinity on the morphological behavior and ionic response ofdifferent commercially important bamboo species	Ahmad, I., B. Jabeen, M. F. Nawaz, M. Asif, M. H. Rashid, M. Hussain, T.H. Farooq,	2022		Fresenius Environmental Bulletin	668-676	31

		Salman, A. and **M. Rafiq**					
	Exploiting the potential of weedy rice as value added silage under different nitrogen levels and cutting intervals	Aniqa Mubeen, Asif Tanveer, Abdul Khaliq and Muhammad Yaseen	2022	-	Pak. J. Agri. Sci.	93-103	59(1)
	Effect of NPK Fertilization Strategies on Growth, Yield, Nutrient Use Efficiency and Economic Benefits of Relay Intercropped Wheat in Cotton	Ali Zohaib, Habib Ullah, Shakeel Ahmad Anjum, Tahira Tabassum, Muzzammil Hussain, Mohsin Nawaz, Ghulam Abbas and Sohail Irshad	2021	-	Pakistan Journal of Agricultural Research	49-57	34 (1)
	Impact of weed competition on growth and yield of proso millet (*Panicum miliaceum* L.): Implications for farmers	Muhammad Younis, Nabeel A. Ikram, Shahid Iqbal, Shakeel Ahmad, Abdul-Ghaffar, Zuhair Hasnain, Ghulam Abbas, Neelam Chaudhary, Aniqa Mubeen, Muhammad A. Wahid and Rao M. Ikram	2021	-	International Journal of Agricultural Extension	329-334	9 (3)
	Harnessing the Potential of Modern Omics Approaches to Study Plant Biotic and Abiotic Stresses *In* Plant Perspectives to Global Climate Changes – Developing Climate Resilient Plants	Rahil Shahzad, Muhammad Munir Iqbal, Shakra Jamil, Nishat Afza, Shakeel Ahmad, Amina Nisar, Shamsa Kanwal, Muhammad Irfan Yousaf, Ghulam Abbas and Sohail Akhter	2021	-	Academic Press Publications, The Elsevier, UK	101-123	Chapter No. 06
	Influence of innovative sowing methods on yield and economics of wheat (*Triticum aestivum*) in rice wheat cropping system.	Mehmood, A., M. Shehzadi, A. Khaliq, M. Shafaqat, R. Sher, M.K. Munir, M. Younus, M.S. Afzal	2021	Influence of innovative sowing methods on yield and economics of wheat (*Triticum aestivum*) in rice wheat cropping system	Journal of Agricultural Research	151-155	59 (2)
	Phosphorus solubilizing bacteria (PSB) in combination with different fertilizer sources to enhance yield performance of chickpea (*Cicer arietinum* L.)	Zafar, N., S. Ahmed, M.K. Munir, M. Saqib, M. Zafar, B.H. Babar, T. Mahmood and F. Ahmed	2021	Effect of different organic and inorganic fertilizer sources on yield of chickpea	Journal of Agricultural Research.	287-293	59 (3)
	Earth worms and vermicomposting: A review on the story of black gold	Ahmad, A., Z. Aslam, K. Belliturk, N. Iqbal, M. Idrees, M. Nawaz, M.Y. Nawaz, M.K. Munir, A. Kamal, Ehsan Ullah, M.A. Jamil, Y. Akram, T. Abbas and M.M. Aziz.	2021		Journal of Innovative Sciences	167-173	7(1)
	Improving the productivity of okra (*Abelmoschus esculentus* L.) by strengthening the	Tanveer, A., M.S. Asghar, M. Sarwar, M.F. Saleem, M.	2021		Pakistan Journal of Agricultural Sciences	1131-1139	58

	impact of applied nutrients through alligator weed compost.	Nadeem, M.K. Munir, M. Zafar, M. Rizwan and G. Sarwar.					
	Boron biofortification through seed coating: a way to alleviate malnutrition and to improve grain yield of bread wheat	Iqbal, S., M. Farooq, A. Ullah, M. Luqman, H.M. Akram, M.K. Munir and N. Zafar	2021	Boron biofortification through seed coating: a way to alleviate malnutrition and to improve grain yield of bread wheat	Pakistan Journal of Agricultural Sciences	1501-1509	58
	Drill sowing and broadcast augmented with furrows improved the performance and profitability of wheat	M.K. Munir, S. Ahmed, N. Zafar, M. Zafar, T. Mahmood, M. Saqib, B.H. Babar, F. Ahmed and Saba	2021	Evaluation of different sowing methods of wheat	Journal of Agricultural Research. Accepted for publication in	361-366	59
Abstract	-	-	-	-	-	-	-
Urdu Article	کپاس کی زیادہ پیداوار کے لیے اف سیزن مینیجمنٹ کی اہمیت	Saba Iqbal, Asmat Ullah, Muhammad Luqman and Hafiz Muhammad Nasrullah	2021	-	Monthly Kisan wing Lahore	-	-
	گندم کا خالص بیج پیدا کرنا	Muhammad Luqman, Saba Iqbal and Asmat Ullah	2021	-	Monthly Kisan wing Lahore		
	گندم – جڑی بوٹیوں کی موثر تلفی	ڈاکٹر محمد رفیق- محمد عاشق- غلام عباس حسنین جواد- انیقہ مبین	2021	-	Zaraat Nama	9-10	22
	سٹیویا کی کاشت	حسنین جواد- انیقہ مبین- ڈاکٹر محمد رفیق- غلام عباس- محمد عاشق-محمد عارف	2021	-	Zaraat Nama	20-21	23
	گندم سے جڑی بوٹیوں کی تلفی کے لیے موثر زہریں	محمد عاشق - ڈاکٹر محمد رفیق- انیقہ مبین - غلام عباس-حسنین جواد	2022	-	Zaraat Nama	21	1
	ادرک کی کاشت	ڈاکٹرمحمدموسیٰ-ڈاکٹر محمد رفیق- انیقہ مبین - محمد عاشق - غلام عباس	2022	-	Zaraat Nama	19	4
	تلسی اور نیاز بو کی کاشت	ڈاکٹرمحمدموسیٰ-ڈاکٹر محمد رفیق- انیقہ مبین - محمد عاشق - غلام عباس	2022	-	Zaraat Nama	13-14	5
	گندم کے لیے آخری آبپاشی کی اہمیت	ڈاکٹر محمد رفیق- انیقہ مبین -محمد عاشق - غلام عباس-حسنین جواد-محمد توصیف	2022	-	Zaraat Nama	18	5
	گندم کی کٹائی، گہائی اور سنبھال	محمد عاشق - ڈاکٹر محمد رفیق - غلام عباس-حسنین جواد- انیقہ مبین -محمد توصیف	2022	-	Zaraat Nama	6-7	7
	لیمن گراس	ڈاکٹرمحمدموسیٰ-ڈاکٹر محمد رفیق-محمد عاشق -حسنین جواد- غلام عباس-انیقہ مبین - محمدتوصیف	2022	-	Zaraat Nama	21	11
	نامیاتی کھادوں کا استعمال	ڈاکٹرمحمدموسیٰ-ڈاکٹر محمد رفیق- انیقہ مبین -محمد عاشق	2022	-	Zaraat Nama	19-20	08
Books	-	-	-	-	-	-	-
Booklets	-	-	-	-	-	-	-

SENIOR SCIENTISTS

Dr. Muhammad Musa
Chief scientist/Principal Scientist
0306-6782882
darifsd84@gmail.com

Dr. Naveed Akhtar
Principal Scientist
0332-6616081
drnaveed_siddiqui1968@yahoo.com

Dr. Muhammad Zafar
Principal Scientist
0322-6253005
zafar_uaf@yahoo.com

Dr. Muhammad Faqir Hussain Anjum
Principal Scientist (Karor)
0301-6090603

arskaror@yahoo.com

Dr. Muhammad Rafiq
Senior Scientist
0333-3366069
rafiq_mdr164@yahoo.com

Dr. Muhammad Kashif Munir
Senior Scientist
0321-7668811
agrihawk.farm@gamil.com

Dr. Muhammad Naeem Khan
Senior Scientist
0333-6503641
naeemfibercrops@gmail.com

Mr. Arshad Hussain
Senior Scientist
0300-8682752
ranaarshadb@gmail.com

Mr. Muhammad Ashiq
Senior Scientist
0300-7657249
ashiqweeds@gmail.com

Dr. Asmatullah
Senior Scientist
0300-6762658
drasmatu@gmail.com

Mr. Abdul Latif Malghani
Senior Scientist
0306-8766298
almalghani@gmail.com

Mr. Fahid Ihsan
Senior Scientist
0333-6263310
Fahid814@gmail.com

Mr. Fiaz Hussain
Senior Scientist
0300-7281282
Fiazaari1981@gmail.com

Mr. Muhammad Luqman
Senior Scientist
0300-7481763
Luqmanars68@gmail.com

Mr. Rizwan Khurshid
Senior Scientist
0300-7694626
fibercrops@gmail.com

Dr. Muhammad Saeed Ashraf
Senior Scientist
0341-5544596
fibercrops@gmail.com