1. AGRONOMY SECTION

The agronomical studies were carried out to explore yield of newly developed cotton strains at CCRI-Sakrand through:

i. To follow the different sowing time by determining its optimum sowing time, proper plant to plant spacing, requirements of inorganic fertilizer, number of irrigation and integrated method of weed management of cotton crop. Testing of seed viability and to increase soil productivity through cultural practices.

ii. To record the meteorological data.

Experiment-wise details are presented as under:

1.1. Effect of sowing dates on seed cotton yield of new cotton cultivar Bt. CRIS-508

The object of this experiment was to determine the optimum sowing time for newly developed cotton cultivar Bt. CRIS-508 and its effect on seed cotton yield with standard commercial cotton variety CRIS-342. The experiment was conducted in Split Plot Design with four replications and plot size was kept at 47.5´x 52.5´. The sowing dates were kept as main plot and cultivars as sub plots. Nitrogen at the rate of 100 kg ha^{-1} in the form of Urea was applied in four split doses i.e. (1^{st}) at 1^{st} irrigation after thinning of the crop (2^{nd}) at 3^{rd} irrigation (3^{rd}) at peak flowering and (4^{th}) at boll formation stage. One bag of DAP fertilizer per acre was applied at the time of sowing. The cultural practices such as weeding, inter-culturing, irrigation and plant protection measures were applied according to need of the crop. The 10 plants were tagged from each variety per sowing date to record the data regarding boll formation at 60, 90, 120 and 150 days after planting and other components from the experiment. The data regarding boll formation is presented in Table 1.1

On an average the data regarding boll formation is given in Table 1.1 which shows that new cultivar Bt. CRIS-508 produced more number of bolls at different times 60, 90, 120 and 150 days after planting (DAP) in different sowing dates. However at 150 DAP all the treatment viz., 15^{th} April (35.2) 1^{st} May (31.2) 15^{th} May (27.6) 1^{st}June (23.4) per plant respectively in comparison to Standard CRIS-342.

Table-1.1: Average number of bolls per plant (Days after planting)

Sowing dates	Varieties	60 DAP*	90 DAP*	120 DAP*	150 DAP*
S_1=15th April	Bt. CRIS-508	2.5	8.5	23.0	35.2
	CRIS-342	1.4	3.2	19.0	33.5
S_2=1st May	Bt. CRIS-508	2.2	6.5	20.0	31.2
	CRIS-342	1.5	4.0	15.1	28.4
S_3=15th May	Bt. CRIS-508	1.7	5.1	18.0	27.6
	CRIS-342	1.5	3.3	15.1	25.2
S_4=1st June	Bt. CRIS-508	1.2	4.5	16.2	23.4
	CRIS-342	1.0	3.5	14.6	21.1

***DAP = Days after planting**

The yield data presented in Table1.2 shows that the new cultivar Bt. CRIS-508 produced significantly higher seed cotton yield of 2939 kg ha^{-1}, 2433 kg ha^{-1}, 1950 kg ha^{-1} and 1853 kg ha^{-1} in different sowing dates viz., 15th April, 1st May, 15th May and 1st June and higher plant height, maximum number of bolls per plant, boll weight and plant population as compared to standard variety CRIS-342. The highest yield was obtained from (S_1) 2939 kg ha^{-1} Bt. CRIS-508 and 2801 kg ha^{-1} CRIS-342 in 15th April sowing and lowest yield was obtained from (S_4) 1853 kg ha^{-1}in Bt. CRIS-508 and 1648 kg ha^{-1} in CRIS-342 in 1st June sowing. However, on an average new cultivar Bt. CRIS-508 observed significantly higher plant height, number of bolls, boll weight and plant population when crop was sown on 15th April, which is the optimum time of sowing for obtaining higher seed cotton yield.

Table-1.2: Plant height (cm), numbers of bolls per plant, boll weight (g), seed cotton yield (kg ha^{-1}) and plant population (ha^{-1}) as influenced by different sowing dates

Sowing dates	Varieties	Plant height (cm)	Number of bolls plant^{-1}	Boll weight (g)	Seed cotton yield (kg ha^{-1})	Plant population (ha^{-1})
S_1 = 15th April	Bt. CRIS-508	158	31.0	3.6	2939	43911
	CRIS-342	154	29.5	3.3	2801	42890
S_2= 1st May	Bt. CRIS-508	148	25.5	3.5	2433	44533
	CRIS-342	141	24.3	3.2	2316	43300
S_3 = 15th May	Bt. CRIS-508	147	21.5	3.3	1950	43857
	CRIS-342	139	19.7	3.1	1786	41896
S_4= 1st June	Bt. CRIS-508	126	20.5	3.2	1853	43715
	CRIS-342	121	18.5	3.0	1648	42518
Sowing dates						
15th April		156	30.2	3.4	2870	43400
1st May		145	24.9	3.3	2374	43916
15th May		143	20.6	3.2	1868	42876
1st June		123	19.5	3.1	1750	43116
Cultivar						
Bt. CRIS-508		145	24.6	3.4	2293	44004
CRIS-342		139	23.0	3.1	2138	42651
CD 5%						
1. Sowing date		**2.83**	**4.62**	**0.28**	**0.41**	**2.86**
2. Cultivar		**2.31**	**1.28**	**0.13**	**6.75**	**6.66**
3. S.D x cultivar		**NS**	**NS**	**NS**	**16.37**	**16.15**

1.2. Response of new cultivar Bt. CRIS-508 to different Nitrogen Doses and Plant Spacing Trial

The experiment was conducted to determine the response of new cotton cultivar Bt.CRIS-508 with four different doses of Nitrogen viz; 50, 100, 150 and 200 kg ha^{-1} and plant to plant spacing of 15, 23 and 30 cm in Split Plot Design with three replications. The Nitrogen fertilizer doses were kept as main plots and plant spacing were kept as sub

plots. The cotton cultivar Bt. CRIS-508 was sown on 12th May, 2014 on flat bed. Two bags of Single Supper Phosphate (SSP) fertilizer was applied at the time of sowing and Nitrogen fertilizer doses were applied in four split doses (1st) at 1st irrigation after thinning of the crop, (2nd) at third irrigation, (3rd) at peak flowering and (4th) at boll formation stage. Crop production and protection measures were adapted as required by the crop.

Data regarding to boll formation is given in Table 1.3 which shows that Nitrogen @ 200 kg ha^{-1} with 30 cm plant to plant spacing produced more number of bolls at different times 60, 90, 120 and 150 days after planting. Different Nitrogen doses produced/contributed maximum numbers of bolls in 30 cm plant to plant spacing at 150 days after planting, viz., 50 kg N ha^{-1} (27.2), 100 kg N ha^{-1} (29.7), 150 kg N ha^{-1} (34.3), 200 kg N ha^{-1} (36.4) per plant respectively compared than 15 cm and 23 cm plant to plant spacing.

Table-1.3: Average number of bolls per plant (Days after planting)

Treatments	Spaces (cm)	60 DAP*	90 DAP*	120 DAP*	150 DAP*
T_1=50 kg N ha^{-1}	15 cm	0.2	8.0	15.0	24.1
	23 cm	0.5	10.5	18.5	25.3
	30 cm	1.8	13.8	23.6	27.2
T_2=100 kg N ha^{-1}	15 cm	0.7	8.5	15.8	25.4
	23 cm	1.2	10.8	20.4	27.5
	30 cm	2.1	14.1	26.5	29.7
T_3=150 kg N ha^{-1}	15 cm	1.3	9.6	18.3	28.6
	23 cm	1.7	11.1	28.2	30.4
	30 cm	1.9	14.8	31.2	34.3
T_4=200 kg N ha^{-1}	15 cm	1.5	10.4	23.5	30.2
	23 cm	2.0	11.4	27.8	32.8
	30 cm	2.7	15.6	33.2	36.4

***DAP = Days after planting**

The yield data and other components presented in Table 1.4 depicts that the maximum seed cotton yield was produced by T_4 (2717 kg ha^{-1}) when 200 kg N ha^{-1} and 30 cm spacing were kept respectively. The results also show that plant height, number of

bolls per plant, boll weight, seed cotton yield kg ha^{-1} and plant population significantly increased with the increase of Nitrogen fertilizer dose. The 30 cm plant to plant spacing at 200 kg N ha^{-1} produced significantly higher seed cotton yield (2717 kg ha^{-1}) and plant population (42770) as compared to other spacing and fertilizer doses. The results also show that with the increase of nitrogen fertilizer 50 N to 100 N and 100 N to150 kg N ha^{-1}, yield was increased in significant ratio but at 150 N to 200 kg N ha^{-1}, yield was not increased in the same ratio as in other treatments.

Table-1.4: Effect of Nitrogen fertilizer and plant spacing on plant height (cm), number of boll, boll weight (g), seed cotton yield (kg ha^{-1}) and plant population (ha^{-1})

Treatments	Spaces (cm)	Plant height (cm)	Number of bolls $plant^{-1}$	Boll weight (g)	Seed cotton yield (kg ha^{-1})	Plant population (ha^{-1})
T_1=50 kg N ha^{-1}	15 cm	127	22.1	3.1	1811	85609
	23 cm	135	23.2	3.3	1950	56694
	30 cm	140	25.3	3.4	2090	42561
T_2=100 kg N ha^{-1}	15 cm	135	25.4	3.2	1853	85191
	23 cm	138	27.3	3.4	2020	56980
	30 cm	146	27.8	3.5	2131	42630
T_3=150 kg N ha^{-1}	15 cm	134	26.6	3.3	2180	85679
	23 cm	140	28.1	3.5	2368	56841
	30 cm	148	29.0	3.7	2577	42700
T_4=200 kg N ha^{-1}	15 cm	137	29.8	3.6	2438	85539
	23 cm	143	30.2	3.8	2647	56742
	30 cm	155	31.5	4.0	2717	42770
Average of Nitrogen						
50 kg N ha^{-1}	-	134	23.5	3.2	1950	61621
100 kg N ha^{-1}	-	139	26.8	3.3	2001	61600
150 kg N ha^{-1}	-	140	27.9	3.5	2375	61740
200 kg N ha^{-1}	-	145	30.5	3.8	2600	61683
Average of spacing						
15 cm	-	133	25.9	3.3	2070	85505
23 cm	-	139	27.2	3.5	2246	56814
30 cm	-	147	28.4	3.6	2378	42665
CD (5%)						
1. Nitrogen	-	**3.61**	**2.16**	**0.22**	**4.80**	**4.71**
2. Plant Spacing	-	**2.11**	**2.02**	**0.24**	**6.12**	**5.27**
3. N x PS	-	**NS**	**NS**	**NS**	**16.04**	**14.14**

1.3. Screening of Herbicide to Control Weeds in Cotton

The experiment was conducted to observe the effect of different chemical and mechanical weeding method for effective weed control on flat bed sowing. Mechanical weed control included interculturing and manual weeding. Whereas, chemical weed control included pre-emergence weedicide application. The trial was laid out in Randomized Complete Block Design with four replications. Cotton cultivar Bt. CRIS-508 was sown on 12th May 2014. The Dual Gold 960 EC Pre-emergence weedicide applied at the rate of 2.0 litre ha^{-1} at the time of seed bed preparation. Interculturing was done at 30, 45 and 60 days after sowing. Manual weeding in dry and wet condition of soil was done three times in the season. One bag of DAP per acre was applied at the time of seed bed preparation (before sowing). Nitrogen fertilizer in the form of Urea at rate of 2 bag/acre was applied in four split doses (1st) at 1st irrigation after thinning of the crop, (2nd) at third irrigation, (3rd) at peak flowering and (4th) at boll formation stage.

Boll formation at different days after planting (DAP) of mechanical and chemical weed control is given in Table 1.5 which shows that T_3 (Dual Gold 960 EC 2.0 litre ha^{-1} + Inter culturing) produced more number of bolls at different times 60, 90, 120 and 150 days after planting compared than others treatments. However, at 150 days after planting all the treatments, viz., T_1 (Inter culturing 3 times) (30.1), T_2 (Dual Gold 960 EC 2.0 litre ha^{-1}) (33.4), T_3 (Dual Gold 960 EC 2.0 litre ha^{-1} + Interculturing) (37.5), T_4 (Interculturing + Manual weeding after irrigation) (35.6) and T_5 (Untreated (Control) (26.3) produced maximum number of bolls per plant.

Table-1.5: Average number of bolls per plant (Days after planting)

Treatments	60 DAP*	90 DAP*	120 DAP*	150 DAP*
T_1 = Interculturing 3 times	1.2	8.9	19.2	30.1
T_2 = Dual Gold 960 EC 2.0 litre ha^{-1}	1.5	11.5	22.6	33.4
T_3 = Dual Gold 960 EC 2.0 litre ha^{-1}+ Interculturing	1.7	14.3	27.5	37.5
T_4 = Interculturing + Manual weeding after irrigation	1.3	10.2	24.3	35.6
T_5 = Untreated (Control)	1.1	5.6	16.3	26.3

***DAP = Days after planting**

The adaptation of mechanical and chemical weed control method caused significant increase in seed cotton yield and its components over untreated treatments (Control). The data presented in Table 1.6 shows that Dual Gold 960 EC 2.0 litre ha^{-1}+ Interculturing (T_3) produced significantly higher plant height (138 cm), number of bolls per plant (31.7), boll weight (3.7 g), seed cotton yield (2834 kg ha^{-1}) and plant population (43846 ha^{-1}) compared than other treatments T_1, T_2, T_4 and T_5 (Control).

Table-1.6: Plant height (cm), number of bolls, boll weight (g), seed cotton yield (kg ha^{-1}), % yield increased over control and plant population as affected by different mechanical and chemical methods for weed control on flat bed sowing

Treatments	Plant height (cm)	Number of bolls $plant^{-1}$	Boll weight (g)	Seed cotton yield (kg ha^{-1})	% yield increased over control	Plant population (ha^{-1})
T_1 = Interculturing 3 times	132	28.4	3.3	2626	80	43727
T_2 = Dual Gold 960 EC 2.0 litre ha^{-1}	134	28.6	3.4	2446	67	42608
T_3 = Dual Gold 960 EC 2.0 litre ha^{-1}+Interculturing	138	31.7	3.7	2834	93	43846
T_4 = Interculturing + Manual weeding after irrigation	135	29.8	3.5	2757	88	40966
T_5 = Untreated (Control)	128	17.5	3.2	1462	--	40538
CD (5 %)	**1.54**	**3.46**	**0.10**	**16.14**	**--**	**15.42**

The weed control data given in Table1.7 shows that at 30 and 60 days after sowing (T_3) Dual Gold 960 EC 2.0 litre ha^{-1}+ Inter culturing gave 87 to 84% maximum control on broad leaves weeds 61 to 68% control on narrow leaves weeds as compared to (T_1) 3 times interculturing 60 to 58% broad leaves and 67 to 49% on narrow leaves. (T_2) Dual Gold 960 EC 2.0 litre ha^{-1} 80 to 71% on broad leaves and 54 to 57% narrow leaves and (T_4) on broad leaves 73 to 75% and narrow leaves weeds 51 to 60% control than un treated plots. The result also shows that Dual Gold 960 EC 2.0 litre ha^{-1}+ Interculturing (T_3) pre-emergence weedicide effectively control the broad leaves weeds as compared to narrow leaves weeds.

Table-1.7: Weed intensity as affected by different mechanical and chemical methods at 30 and 60 days after planting on flat bed sowing

Treatments	No. of weeds at 30 DAP*				No. of weeds of 60 DAP*			
	No. of weeds (m^2)		Weed control (%)		No. of weeds (m^2)		Weed control (%)	
	Broad leaves	Narrow leaves	Broad leaves	Narrow leaves	Broad leaves	Narrow leaves	Broad leaves	Narrow leaves
T1 = Interculturing 3 times	0.6	2.3	60	67	5.2	21.5	58	49
T2 = Dual Gold 960 EC 2.0 litre ha^{-1}	0.3	2.0	80	54	3.6	17.9	71	57
T3 = Dual Gold 960 EC 2.0 litre ha^{-1}+ Interculturing	0.2	1.7	87	61	2.0	13.5	84	68
T4 = Interculturing + Manual weeding after irrigation	0.4	2.1	73	51	3.1	16.7	75	60
T5 = Untreated (Control)	1.5	4.3	-	-	12.3	42	-	-

***DAP = Days after planting**

1.4. Testing of commercial varieties of Sindh V/S Punjab under Sakrand climatic condition

The trial was conducted to compare the performance of commercial varieties of Sindh and Punjab under Sakrand climatic condition. Five commercial varieties of Sindh viz; CRIS-342, CRIS-134, Sadori, Hari dost, Shahbaz and seven varieties of Punjab viz; CIM-496, CIM-499, CIM-506, CIM-534, MNH-786, BH-160 and BH-167 were tested. Sowing was done on 24th May 2014. The plot size was kept as 15´ x 110´. The Nitrogen at the rate of 100 kg ha^{-1} in the form of Urea was applied in four split doses i.e. (1st) at 1st irrigation, (2nd) at 3rd irrigation, (3rd) at peak flowering and (4th) dose at boll formation. One bag of DAP/acre was applied at the time of sowing, cultural practices such as weeding, interculturing, irrigation and plant protection measures were commonly adapted as and when required. Plant population of all commercial varieties was non-significant.

On an average the data regarding boll formation is given in Table 1.8 which shows that CRIS-342 produced more number of bolls at different times 60, 90, 120 and 150 days after planting (3.1), (14.3), (32.5) and (35.3) respectively as compared the other varieties.

Table-1.8: Average number of bolls per plant (Days after planting)

Varieties	60 DAP*	90 DAP*	120 DAP*	150 DAP*
CRIS-342	3.1	14.3	32.5	35.3
CRIS-134	2.5	9.5	27.8	31.4
Sadori	1.8	4.6	20.5	22.2
Hari dost	1.6	6.9	18.6	29.4
Shahbaz	1.5	4.8	16.2	26.5
CIM-496	1.4	5.1	17.8	25.7
CIM-499	1.6	10.3	22.5	28.1
CIM-506	1.9	7.8	24.3	25.2
MNH-786	1.8	5.9	21.8	30.1
CIM-534	1.0	6.8	19.8	28.1
BH-160	1.5	5.2	18.3	26.2
BH-167	1.3	5.3	20.2	23.4

***DAP = Days after planting**

The data presented in Table 1.9 indicates that CRIS-342 produced significantly maximum seed cotton yield (3261 kg ha^{-1}). Meanwhile Sadori and BH-167 produced lowest seed cotton yield of 2087 kg ha^{-1}. Significantly maximum number of bolls per plant (33.5) and (31.2) of CRIS-342 and CRIS-134 was recorded respectively. The maximum boll weight (3.6 g) was recorded at 150 days after sowing from BH-160 followed by CRIS-134 (3.3), BH-167 (3.3), Sadori (3.2), CIM-496 (3.2), Hari dost (3.1) and CIM-506 (3.1). CIM-534 GOT 40.5 % followed by Hari dost (38.4 %) and CIM-496 (38.3 %) while BH-167 measured longer staple length (29.6 mm) followed by BH-160 (28.6 mm), CIM-534 and CIM-499 (28.5 mm).

Table-1.9: Performance of Sindh and Punjab Varieties under Sakrand climatic condition

Varieties	Number of bolls plant^{-1}	Boll weight (g)	GOT (%)	Staple length (mm)	Seed Cotton Yield (kg ha^{-1})	Plant population (ha^{-1})
CRIS-342	33.5	2.8	38.0	27.8	3261	43533
CRIS-134	31.2	3.3	37.7	27.5	2935	42729
Sadori	21.5	3.2	37.6	28.4	2087	41468
Hari dost	28.4	3.1	38.4	28.2	2609	44598
Shahbaz	26.2	2.8	35.8	27.3	2478	40986
CIM-496	28.4	3.2	38.3	28.2	2348	43694
CIM-499	27.5	2.7	35.2	28.5	2609	42766
CIM-506	24.6	3.1	36.8	27.7	2283	43402
MNH-786	27.7	2.9	37.9	27.6	2674	45335
CIM-534	26.4	2.9	40.5	28.5	2544	40833
BH-160	24.5	3.6	36.8	28.6	2348	43663
BH-167	22.1	3.3	37.3	29.6	2087	44468
CD (5 %)	**3.43**	**0.36**	**NS**	**NS**	**0.99**	**15.29**