

**Evaluation of yield, yield components and incidence of CLCV disease through planting times and varietal interaction in cotton at Multan region**

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Five Bt cotton varieties were evaluated for five different parameters (plant height, number of bolls per plant, boll weight, seed cotton yield and CLCV incidence after 105 days of planting) under six different sowing times (01 March, 15 March, 01 April, 15 April, 01 May and 15 May) at CCRI, Multan during the year 2018. Results revealed highly significant differences among the varieties, sowing times and their interaction for all the traits under study. Regarding sowing times, highest yield (3676 kg/ha) was produced when the sowing was done on 01 March followed by March 15 sowing (3496 kg/ha) with 4.3 and 6.1 CLCuV incidence% respectively after 105 days of sowing. However, lowest yield of 2483 kg/ha was achieved through 15 May planting with 96.7% CLCuV incidence. Regarding varietal performance, CYTO-313 excelled all other varieties by producing 3356 kg/ha seed cotton yield followed by CIM-343 (3195 kg/ha) with CLCuV percent incidence of 53.1 and 50.9 respectively at 105 days of planting. It was concluded from the present investigations that first March sowing is the optimum sowing time with zero percent CLCuV incidence for Multan region. Furthermore, variety CYTO-313 should be given primacy on other four varieties when farmer is going to adopt first March sowing.

Key word: Cotton, CLCV, Pakistan, Multan, virus.

INTRODUCTION: Cotton (*Gossypium hirsutum* L.) is an important cash crop and a significant source of foreign exchange earnings thus rightly called the back bone of Pakistan's economy. Pakistan is 4th largest cotton producer in the world after China, USA and India (GOP, Cotistics, 2018). Cotton is a major crop of Pakistan after wheat; it occupies the largest area in Pakistan compared to other crops. It earns the country's largest export revenues. In Pakistan, cotton was cultivated on an area of 2700 thousand hectares (approx. 6672 thousand acres) during the year 2017-18 with the production of 11.95 million bales, whereas, the lint yield in Pakistan for the same year was 752 kg/ha (approx. 305 kg acre). In Punjab, almost 100% Bt cotton with MON 531 event and Cry1Ac gene was sown on an area of 2053 thousand hectares (approx. 5073 thousand acres) during 2017 year which produced 8.08 million bales with lint yield of 669 kg/ha during the year 2017-18 (GOP, Cotistics, 2018). Five year's (2013-14 to 2017-18) data regarding cotton area, production and lint yield for Pakistan, Punjab and Sindh are depicted in table 1. However, Punjab's area, production and yield (1947 7116 and 621 respectively) in 2018 declined by 5-7%.

The decline in phutti yield may be due to many problems such as weed infestation, insect pest and disease problems, water shortage, excess salinity, low germination of seed, conventional sowing methods, poor soil management practices, flower and boll shedding, too early or too late sowing and nature of cultivars. Cotton crop is very sensitive to environmental conditions and grown in a wide range of ecological zones. A number of factors such as, plant density, sowing time, nutrients and water management practices are involved in getting a profitable yield (Ali, et al., 2009). Seed cotton yield could be increased significantly if we know the optimum sowing time of a variety for a particular area/zone. A better crop growth is ensured by the appropriate coordination of different agronomic

practices and judicious use of various inputs and among these, planting date is very important to explore the potential of a cultivar in the region. Interaction of genotype by sowing date (G × S) is an important strategy to analyze crop yield and quality in an environment (Campbell & Jones, 2005). Genotype selection and sowing date management are important factors that can have a large impact on yield and quality attributes of cotton crop (Deho et al., 2012). These two factors mostly limit cotton growth, yield and quality as growth is a function of the product of genotype and environment (Sarwaret et al., 2012; Zeng et al., 2014). According to studies conducted in Faisalabad region (Arshad et al., 2007), cotton should be sown up to May 20 to get good yield. In late sowing, yield and other components decrease considerably. SLH-284 gave best results for yield and yield components under this study. Hassan, et al. (2003) concluded that on an average of two years data, 15th May produced highest seed cotton yield of 3513 kg/ha, whereas the lowest yield of 238 kg/ha was produced when the sowing was done on 15th July. They also concluded that MNH-552 gave best results for yield and yield components. However, research results revealed by (Iqbal et al., 2012) demonstrated that early sown cotton contributes more towards vegetative growth rather than to yield, moreover, early sown cotton reaches reproductive phase in the hottest month of the year that causes serious yield losses (Rahman et al., 2007). Contrary to this, late planting causes flowering and maturity when temperature is much cold. Consequently, cotton yield and quality is affected due to unfavorable environmental conditions and shorter growth period (Elayan et al., 2015). Usmani, et al. (2016) also studied sowing date and genotype interaction in a trial having six sowing dates and four genotypes in the Dera Ismail Khan region. They concluded that the genotype, CIM-599 sown on April 19 suits well to the study area and had the potential to optimize cotton yield and quality in irrigated condition of Dera

Ismail Khan, Pakistan. Present studies were under taken at CCRI, Multan to evaluate the differences in the yield and yield components of three cotton cultivars under five sowing times/dates.

MATERIAL AND METHODS: Five *Bt.* cotton varieties (CYTO-515, CIM-632, CYTO-313, CIM-343, and CIM-602) all the varieties name should be like this *Bt. Cyto-515, Bt. CIM-632, Bt. Cyto-313, Bt. CIM-343, and Bt. CIM-602*) were evaluated through six different sowing times (01 March, 15 March, 01 April, 15 April, 01 May and 15 May) at CCRI, Multan during the year 2018. The trial had split plot design, sowing times were kept in main plots, whereas, varieties in sub-plots replicated four times. Bed-furrows were made in a properly pulverized soil with dry condition and then bed shaping was done. Dual Gold 960 EC weedicide was sprayed at the dose of two liters per hectare as a pre-emergence after sowing how much later? on moist beds. Seed was sown at 25 cm plant to plant distance by dibbling method and then irrigation was applied. Other cultural practices and plant protection measures were adopted when and where needed. Data was recorded on plant height, number of bolls per plant, boll weight, seed cotton yield and CLCuV incidence after 105 days of planting why CLCuV data were recorded after 105DAP. Because higher intensity of the disease appear late Plot-wise and replication-wise picking was done when crop was fully matured. The data were statistically analyzed after Gomez and Gomez (1984) calculating CD values at 5 % probability level to distinguish results for sowing times, varieties and their interaction.

RESULTS AND DISCUSSION: Five *Bt* cotton varieties (CYTO-515, CIM-632, CYTO-313, CIM-343, and CIM-602) were evaluated in six different sowing times (01 March, 15 March, 01 April, 15 April, 01 May and 15 May) for five different parameters (plant height, number of bolls per plant, boll weight, seed cotton yield and CLCuV incidence after 105 days of planting) at CCRI, Multan during the year 2018. Results revealed highly significant differences among yield, varieties, sowing time, CLCV disease incidence percent after 105 DAP and their interactions which is clear from the statistical values (CD5%) given in table 2. The parameter-wise results are presented and discussed here under:

Plant height: Table 2 demonstrated that maximum plant height (140.3 cm) was observed when sowing was done on March 01, whereas, minimum plant height (116.0 cm) was observed in May 15 sowing date. The plant height decreased gradually from early planting to late planting. Obviously early sowing got more inputs (irrigation, fertilizer etc) as compared to late planting thus plant height was maximum. Looking at varietal behavior regarding plant height, CIM-632 was measured as taller variety (132.8 cm) and CIM-602 had the smaller height (119.9 cm). Present research findings are in line with the findings of Arshad *et al.*, 2007 and Iqbal *et al.*, 2012.

Number of bolls per plant: Number of bolls per plant plays key role in achieving good seed cotton yield and is positively correlated with yield parameter. Table 2 demonstrated that number of bolls per plant was maximum (37.0) in March 01 sowing, while minimum bolls per plant was achieved when the sowing was done on 15 May. In early sown crop stood more days in the field therefore number of bolls also was more than other sowing times. Gradual decrease in boll formation was observed from early to late planting of the crop, thus late

sowing (May 15) produced minimum number of bolls per plant (24.8) as compared to other sowing times. When the varietal performance in different sowing times was checked (table 2), it was noted that CYTO-313 produced highest number of bolls per plant (33.5), whereas, minimum number of bolls per plant was produced by CIM-632 (27.0). Varieties were statistically different from each other in boll formation. According to (Elayan *et al.*, 2015), cotton yield and quality is affected due to unfavorable environmental conditions and shorter growth period. This study has also demonstrated similar results as of Elayan *et al.*, (2015), Arshad *et al.*, (2007) and Iqbal *et al.*, (2012). However, present results are in contradiction with those of Rahman *et al.*, (2007) who revealed that early sown cotton reaches reproductive phase in the hottest month of the year that causes serious yield losses.

Boll weight: Very little differences for boll weight were observed among the sowing times (Table 2). However, heavier bolls of 2.92g were produced when the crop was sown late (May 15), whereas March 01 sown crop produced lighter weight bolls. Varieties Cyto-313, and CIM-602 produced heavier bolls (3.03 g) as compared to other varieties included in this trial. Varietal selection and sowing time management are important factors that can have a large impact on yield and quality attributes of cotton crop (Deho *et al.*, 2012). These two factors mostly limit cotton growth, yield and quality as growth is a function of the product of genotype and environment (Sarwaret *et al.*, 2012; Zeng *et al.*, 2014). In the present studies, variety x sowing date interaction showed little effect.

Seed cotton yield: Seed Cotton yield is the product of number of bolls and is positively correlated with this parameter. Maximum the number of bolls, maximum will be the production of seed cotton only for those varieties who have equal boll weight otherwise vice versa. Table 2 demonstrated that the crop sown on March 01, produced maximum number of bolls obviously the maximum seed cotton yield (3676 kg/ha). When the sowing was shifted from earlier to late sowing time, the seed cotton yield also decreased linearly and lowest seed cotton yield was observed (2483 kg/ha) from the late sown crop (May 15). When varietal performance regarding this parameter was looked at, table 2 revealed that CYTO-313 yielded highest seed cotton yield of 3356 kg/ha followed by CIM-343 variety which produced 3195 kg/ha seed cotton. The lowest yield, however, was observed in CIM-632 variety with 2593 kg/ha of seed cotton yield. Sowing time, variety and their interaction portrayed greater impact on seed cotton yield. Present results are in conformity with the results reported by Elayan *et al.*, (2015), Arshad *et al.*, (2007) and Iqbal *et al.*, (2012). However, present results contradict results reported by Rahman *et al.*, (2007) who narrated that early sown cotton reaches reproductive phase in the hottest month of the year that causes serious yield losses.

CLCuV disease incidence percent at 105 dap: The results presented in table 2, revealed that after 105 days of planting, when the crop was inspected to record the data regarding CLCV disease percent incidence, it was observed that March 01 sowing time recorded minimum and negligible CLCV disease even one variety CYTO-515 had zero percent disease incidence. As much as the varieties were kept sown later and later, the disease started appearing. The disease incidence range recorded was from 4.3 to 96.7% (minimum in March 01 sowing

Table 1: Pakistan, Punjab and Sindh Cotton Area, Production and Yield for last five years (2013-14 to 2017-18)

Year-Wise	2013-14	2014-15	2015-16	2016-17	2017-18
PAKISTAN					
Area (000 hectares)	2805.65	2958.30	2901.98	2488.97	2700.27
Production (000 million bales)	12768.88	13959.58	9917.41	10671.00	11945.60
Yield (kg/ha)	774	802	581	729	752
PUNJAB					
Area (000 hectares)	2199.02	2322.85	2242.72	1815.34	2052.93
Production (000 million bales)	9145.00	10277.00	6343.00	6978.00	8077.00
Yield (kg/ha)	707	752	481	653	669
SINDH					
Area (000 hectares)	567.98	596.21	621.25	636.65	611.68
Production (000 million bales)	3523.42	3572.54	3475.60	3596.88	3775.76
Yield (kg/ha)	1055	1019	951	960	1049

Source: Cotistics August 2018 Bulletin published by Pakistan Central Cotton Committee, Multan.

Table 2: Yield, yield components and CLCuV incidence of different genotypes as affected by different sowing times at CCRI, Multan during the cotton crop season 2018-19.

Sowing Times	Varieties	Plant height (cm)	Bolls per plant	Boll weight (g)	Seed yield (kg/ha)	cotton	CLCuV incidence (%at 105 DAP*)	disease
March 01	CYTO-515	142.7	38	2.92	3788		0.0	
	CIM-632	144.4	34	2.64	3304		2.0	
	CYTO-313	142.6	40	2.70	4030		4.1	
	CIM-343	138.8	38	2.86	3780		4.9	
	CIM-602	132.9	35	2.68	3476		10.7	
Av		140.28	37	2.76	3675.6		4.34	
March 15	CYTO-515	139.1	36	2.96	3628		3.6	
	CIM-632	140.9	31	2.65	3014		4.1	
	CYTO-313	139.5	38	2.73	3826		6.9	
	CIM-343	133.2	37	2.93	3676		6.6	
	CIM-602	127.9	33	2.70	3338		9.3	
Av		136.12	35	2.794	3496.4		6.1	
April 01	CYTO-515	129.2	31	3.02	3163		26.8	
	CIM-632	134.8	27	2.66	2630		39.0	
	CYTO-313	127.9	35	2.75	3489		33.3	
	CIM-343	125.3	33	3.00	3350		32.4	
	CIM-602	123.8	30	2.72	3022		32.8	
Av		128.2	31.2	2.83	3130.8		32.86	
April 15	CYTO-515	126.0	28	3.04	2874		76.1	
	CIM-632	130.3	25	2.69	2347		81.6	
	CYTO-313	127.5	32	2.76	3204		86.4	
	CIM-343	121.1	29	3.07	2918		72.7	
	CIM-602	119.7	28	2.72	2829		92.2	
Av		124.92	28.4	2.856	2834.4		81.8	
May 01	CYTO-515	122.9	27	3.11	2695		83.8	
	CIM-632	127.1	23	2.73	2174		89.2	
	CYTO-313	123.1	29	1.78	2875		91.8	
	CIM-343	118.7	28	3.13	2827		90.8	
	CIM-602	110.5	26	2.76	2604		92.9	
Av		120.46	26.6	2.702	2635		89.7	
May 15	CYTO-515	119.8	25	3.13	2562		94.8	
	CIM-632	119.1	22	2.74	2086		97.0	
	CYTO-313	120.3	27	2.80	2710		96.1	
	CIM-343	116.3	26	3.16	2616		98.0	
	CIM-602	104.7	24	2.79	2442		97.9	
Av		116.04	24.8	2.924	2483.2		96.76	

Sub-Effects of Sowing Times

Sowing times	Plant height (cm)	Bolls per plant	Boll weight (g)	Seed cotton yield (kg/ha)	CLCuV disease incidence (% at 105 dap*)
March 01	140.3	37.0	2.76	3676	4.3
March 15	136.1	35.0	2.79	3496	6.1
April 01	128.2	31.2	2.83	3131	32.9
April 15	124.9	28.4	2.86	2834	81.8
May 01	120.5	26.6	2.90	2635	89.7
May 15	116.0	24.8	2.92	2483	96.7

Sub-Effects of Varieties

Varieties	Plant height (cm)	Bolls per plant	Boll weight (g)	Seed cotton yield (kg/ha)	CLCuV disease incidence (% at 105 dap*)
CYTO-515	130.0	30.8	3.03	3118	47.5
CIM-632	132.8	27.0	2.69	2593	52.2
CYTO-313	130.2	33.5	2.75	3356	53.1
CIM-343	125.6	31.8	3.03	3195	50.9
CIM-602	119.9	29.3	2.73	2952	56.0
CD 5%					
Sowing Times (ST)	13.01	2.16	0.13	174.05	5.73
Varieties (V)	7.47	1.98	0.14	155.20	2.79
ST x V	20.88	4.83	0.34	381.70	8.26

* = days after planting

Note: Data extracted from Annual Progress Report 2018 of CCRI, Multan which is thankfully acknowledged.

and maximum in May 15 sowing). Thus the results clearly indicate that early sown crop could escape from CLCV disease disaster and may produce higher yield due to almost free of this menace. However, in varieties, the range of CLCV disease incidence percent effects were recorded from 47.5% (CYTO-515) to 56.0% (CIM-602) after 105 days of planting.

CONCLUSION

To avoid CLCuV disease incidence and to get profitable seed cotton yield, March 01 sowing is the optimum sowing time for Multan region. Variety CYTO-313 continuously produced superior yield as compared to other four varieties in all the sowing times/dates.

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