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Research Article

Cotton CO17- A short duration, high yielding compact variety suitable for high density planting system

M. Gunasekaran, N. Premalatha, M. Kumar, L. Mahalingam, N. Sakthivel, K. Senguttuvan, P. Latha, N. Meenakhshiganesan, S. Rajeswari and S.Geetha

Department of Cotton, Centre for Plant Breeding and Genetics, TNAU, Coimbatore – 641 003, Tamil Nadu, India.
***E-Mail**: cotton@tnau.ac.in, npremalatha@gmail.com

Abstract
The cotton compact variety CO 17 (culture TCH 1819) is a short duration genotype (125-130 days) with synchronized boll maturity suitable for high density planting system (HDPS) was released by Tamil Nadu Agricultural University, Coimbatore during 2020. This variety was developed at Department of Cotton, TNAU, Coimbatore through hybridization involving Khandwa 2 and LH 2220 followed by pedigree breeding. The variety possesses zero monopodia with short sympodial length and is highly suited for high density planting system. It recorded an average seed cotton yield of 2361 kg/ha which is 18.9% increase over the check variety Suraj (National check entry identified for HDPS). Culture TCH 1819 recorded seed cotton yield of 3427 kg/ha which was 21.7 % increase over Suraj and 29.0 % increase over MCU 7 under rice fallow condition. It recorded seed cotton yield of 2051 kg/ha which was 13.8 % increase over Suraj under summer irrigated conditions and also recorded 1604 kg/ha of seed cotton yield under winter rainfed which was 20.1 % increase over the check Suraj. This culture was also evaluated in All India Coordinated Cotton Improvement Project trials for two years during 2016-17 and 2017-18 across ten locations. It registered seed cotton yield of 1850 kg/ha which was 37.9 % increase over Suraj.TCH 1819 culture recorded Upper Half Mean Length (UHML) of 27 mm with bundle strength of 26.9 g/tex. It can spin upto 40's counts.

Key words
Cotton, *Gossypium hirsutum* L., compact plant type, high density planting system (HDPS)

INTRODUCTION

Cotton is one of the most important fiber and cash crop of India and plays a dominant role in the industrial and agricultural economy of the country. It provides the basic raw material (cotton fibre) to cotton textile industry. Four species in *Gossypium*, *viz., Gossypium herbaceum, Gossypium arboreum, Gossypium hirsutum* and *Gossypium barbadense* are cultivated ones. The most widely cultivated species *Gossypium hirsutum*also known as upland cotton, constituting more than 92% of the world's cotton production. In India, the seed cotton yield per unit area is still far below than many other cotton growing countries in the world. Various techniques like maintaining suitable plant density, use of optimum dose of fertilizers, growth regulators etc., are being used to overcome the constraints in cotton production. The optimum level of cotton population would however depend on the plant type. The present day cotton genotypes are of long duration with 180-200 days; tall growing with long sympodial growth habit leading to bushy appearance. Long duration varieties with longer sympodial plant type require more number of pickings which leads to increase in cost of cotton cultivation especially because of manual picking. At present, in India, entire cotton is picked manually which is labour intensive and is becoming expensive day by day. Machine picking is a viable alternative to manual picking which will not only minimize cost of cultivation, but also reduce the dependency on labour. Cotton productivity depends on various factors among them selection of potential genotypes along with plant densities play a vital role in increasing the productivity of cotton. However,

the prerequisite for machine picking is the identification of cotton genotypes with short stature, earliness, compactness and short sympodia with synchronous boll bursting.

High density planting system (HDPS) crop is characterized with synchronized flowering and uniform boll bursting with early cut off. Cotton planted under HDPS need 25% additional fertilizers over the recommendation for varieties. The nutrient uptake efficiency improved under HDPS. It is highly suitable for mechanical harvest and the tender stalks and leaves can be ploughed back in to the soil to enrich the soil carbon. Semi-compact genotypes like PKV 081, Suraj, NH 615, NH 630, ADB 39, LRK 516, F2383, CSH 3075, ADB 39, NDLH 1938 in *G. hirsutum* and Phule Dhanwantary and AKA 7 in *G. arboreum*, have morphological traits to fit into HDPS at appropriate row spacing. In these genotypes the average yield improvement under HDPS was around 30% over the recommended spacing (60x30 cm) and the earliness was around 10 days (Cotton Association of India, 2019-20). Leena *et al.,* (2018) reported that the seed cotton yield was invariably increased with closer planting of 45×10 cm and also stated that the genotype AKH081 performed well under closer planting 45 × 10 cm and it may highly suitable for high density planting system. The productivity of cotton can be enhanced by developing varieties suitable for high density planting system(HDPS) with compact plant types in comparison to presently cultivated robust types (Murthy *et al.* 2017). Against this background, development of compact cotton genotypes forms one of the major goals in the modern cotton breeding strategies as it presents an added advantage of requiring two pickings only. Therefore, research efforts were undertaken to identify and evaluate the compact cotton cultures available in the Department of Cotton, TNAU, Coimbatore which resulted in the release of new compact cotton variety CO 17 (TCH 1819).

MATERIALS AND METHODS

The variety CO 17 is derivative of the cross between Khandwa 2 x LH 2220. The crossing programme was initiated during 2008-09 at Department of Cotton, Tamil Nadu Agricultural University, Coimbatore. The segregating progenies with compact plant type were selected following pedigree breeding method by combining yield and fibre quality traits and advanced during 2009-2012.The homozygous lines of the culture TCH 1819 were evaluated in Station Trials during 2012-2013 with the check Suraj. It was tested in Multilocation Trials (MLT) in different research stations of TNAU between 2014-15 and 2015-2016. Based on its superior performance in yield over the check, the culture was evaluated in Adaptive Research Trial (ART) in 92 locations under three different cotton growing seasons *viz.,* rice fallow, winter rainfed and summer irrigated conditions during 2016, 2017 and 2018.

The culture TCH 1819 was also evaluated in All India Coordinated Cotton Improvement Project trials for two years during 2016-17 and 2017-18 across ten locations. Spacing experiments *viz.,* 100 x 10 cm, 60 x 15 cm and 75 x 30 cm and different doses of fertilizers *viz.,* 100 % RDF, 125 % RDF and150 % RDF under closer spacing were evaluated during 2015-16 and 2017-18. On Farm Trials (OFTs) were conducted in 77 locations under three different environments *viz.,* rice fallow, winter rainfed and summer irrigated conditions during 2016, 2017 and 2018. For fibre quality traits, full spinning test was assessed at CIRCOT Mumbai and the results were obtained by HVI mode. Based on the superiority over the station trials *viz*., MLT, ART, OFT, the culture TCH 1819 was proposed for release as Cotton CO 17 variety. During 2020, the State Variety Release Committee approved and released as Cotton CO 17.

Table 1. Overall performance of cotton culture TCH 1819 (CO 17)

Name of the Season	Name of the trials	Number of trials	Seed cotton yield (kg/ ha)		Mean seed cotton yield (kg/ ha) in different seasons		Per cent increase over Suraj
			TCH 1819	Suraj	TCH 1819*	Suraj*	
Winter rainfed	MLT	2	2261	1785			
(Sep. – Feb.)	ART	19	1324	1242	1604	1336	20.1
	OFT	31	1690	1453			
Rice fallow	ART	36	4530	3866			
(Jan. – May)	OFT	39	2408	1849	3427	2817	21.7
Summer Irrigated	MLT	2	2225	1790			
(Feb. – July)	ART	37	2055	1811	2051	1803	13.8
	OFT	7	1977	1766			
	Total trials	**175**	**Overall mean**		**2361**	**1985**	**18.9**

*weighted mean

RESULTS AND DISCUSSION

The overall performance of the compact culture TCH 1819 was summarized in **Table 1**. This culture has registered seed cotton yield of 1604 kg/ha over the check Suraj (1336 kg/ha) which was 20.1 per cent increase over the check in 54 locations under winter rainfed condition evaluated between 2014 and 2018 (**Table 2**). This culture also recorded the seed cotton yield of 3127 kg under rice fallow condition in 75 locations including ART and OFT, which was 21.7and 29.0 per cent increase over the check Suraj and MCU 7 respectively during 2016-2019 (**Table 3**). This culture also tested under summer irrigated during 2016-2019 and had registered seed cotton yield of 2051 kg/ha which was 13.8 per cent increase over the check Suraj (1803 kg/ha) in 46 locations (**Table 4**).

Table 2. Performance of TCH 1819 (CO 17) under Winter rainfed conditions (September- February)

	No. of Locations	Locations	Seed cotton yield (kg/ha)				
			TCH 1819	Suraj	KC 3	SVPR 4	*Bt*hybrid
MLT							
2014-15	2	Veppanthattai and Kovilpatti	1934	1404	1456	-	-
2015-16	2	Veppanthattai and Kovilpatti	2587	2165	2098	-	-
	4	**Mean**	**2261**	**1785**	**1777**	**-**	**-**
	% increase over check			**26.7%**	**27.2%**		
ART							
2016-17	10	Perambalur, Madurai Virudhunagar	1260	1266	1243		
2017-18	9	Perambalur, Madurai Virudhunagar	1387	1218	1246		
	19	**Mean**	**1324**	**1242**	**1245**		
	% increase over check			**6.6%**	**6.4%**		
OFT							
2016-17	12	Madurai, Virudhunagar, Perambalur	1219	-	-	911	1153
2017-18	7	Tuticorin, Virudhunagar	1595	-	-	1441	-
	31	**Mean**	**1690**			**1453**	**1496**
						16.3%	**13.0%**
	54	**Weighted mean**	**1604**	**1336**	**1338**	**1453**	**1496**
		% increase over check		**20.1%**	**19.9%**	**10.4%**	**7.2%**

Table 3. Performance of TCH 1819 (CO 17) under Rice fallow conditions (January - May)

Trials	No. of Locations	Locations	Seed cotton yield (kg/ha)			
			TCH 1819	Suraj	MCU 7	*Bt*hybrid
ART						
2016-17	8	Thanjavur, Tiruvarur	4865	4518	-	-
2017-18	10	Thanjavur, Tiruvarur	4994	3808	-	-
2018-19	18	Thanjavur, Tiruvarur, Tirunelveli, Nagapattinam	3730	3273	3083	-
	36	**Mean**	**4530**	**3866**	**3083**	-
				17.2 %	**46.9 %**	
OFT						
2016-17	28	Thiruvarur, Thanjavur	2388	2067	-	2029
2018-19	11	Thiruvarur, Thanjavur	2428	1630	1958	-
	39	**Mean**	**2408**	**1849**	**1958**	**2029**
				30.2%	**23.0%**	**18.7%**
Total	**75**	**Weighted mean**	**3427**	**2817**	**2656**	**-**
				21.7%	**29.0%**	**-**

Table 4. Performance of TCH 1819 (CO 17) under Summer irrigated conditions (February- July)

Trials	No. of Locations	Locations	Seed cotton yield (kg/ha)		
			TCH 1819	Suraj	*Bt* hybrid
MLT					
2015-2016	2	Coimbatore and Srivilliputtur	2224	1790	-
	2	**Mean**	**2224**	**1790**	**-**
		% increase over check		**24.%**	
ART					
2016-17	16	Virudhunagar, Madurai, Tirchy, Dindigul, Salem, Theni	1449	1384	-
2017-18	21	Tirchy, Dindigul, Tuticorin, Tiruvarur, Tanjavur, Thiruvarur, Salem, Theni	2660	2237	-
	37	**Mean**	**2055**	**1811**	-
		% increase over check		**13.5 %**	
OFT					
2016	3	Madurai, Virudhunagar, Namakkal	2208	1893	2013
2017	3	Namakkal, Virudhunagar	1871	1983	1453
2019	1	Coimbatore	1851	1421	-
	7	**Mean**	**1977**	**1766**	**1733**
		% increase over check		**12.0%**	**14.1%**
	46	**Weighted mean**	**2051**	**1803**	**1733**
		% increase over check		**13.8%**	**18.4%**

Table 5. Performance of TCH 1819 (CO 17) in AICRP Br 06(a) IET & CVT (CZ) during 2016-17 & 2017-18

Sl. No.	Location	Seed cotton yield (kg/ha)		Local check	Per cent increase over check
		TCH 1819	Suraj (Zonal check)		
AICRP Br 06(a) IET- National trial (2016-17)					
1.	Bhawanipatna	1955	1690	1690 (Suraj)	15.7
2.	Rahuri	2004	-	1385 (Phule 688)	44.7
3.	Raichur	3569	-	3255 (RAH 100)	9.6
4.	Lam	2724	-	1475 (L 604)	84.7
5.	Coimbatore	933	1508	1508 (Suraj)	-
AICRP Br 06(a) CVT- Central Zone (2017-18)					
1.	Banswara	2025	1628	-	-
2.	Khandwa	969	516	-	-
3.	Talod	2427	1826	-	-
4.	Rahuri	1620	955	-	-
5.	Bhawanipatna	2211	1785	-	-
	Mean	**1850**	**1342**		
Per cent increase over Suraj			**37.9**		

Table 6. Full scale spinning test by HVI mode received from CIRCOT, Mumbai

Mode of testing	Culture Name	HVI mode				Full spinning (CIRCOT Method)			C.S.P
						Actual			
		UHML	UI %	Mic.	Tenacity 3.2 mm g/tex	Nominal count in Ne	Count (Ne)	Strength (lb)	
Fibre quality traits	TCH 1819	26.9	83	4.3	26.9	50	50.3	40.6	2042
						60	58.3	36.6	2134

Table 7a. Fibre quality parameters of TCH 1819 culture in AICRP trial (Br.06a) 2016-17

S.No.	Location	2.5% span length (mm)	Bundle strength (g/tex)	Micronaire value (µg/inch)
1.	Faridkot	28.6	29.2	5.2
2.	Sriganganagar	26.6	26.5	4.7
3.	Bhawanipatna	29.7	31.2	4.6
4.	Rahuri	29.0	37.6	4.5
5.	Raichur	28.6	29.0	4.8
6.	Lam	27.5	29.8	3.6
7.	Coimbatore	29.4	31.3	4.7
	Mean	**28.5**	**30.7**	**4.6**

Table 7b. Fibre quality parameters of TCH 1819 culture in AICRP trial (Br.06a) 2017-18

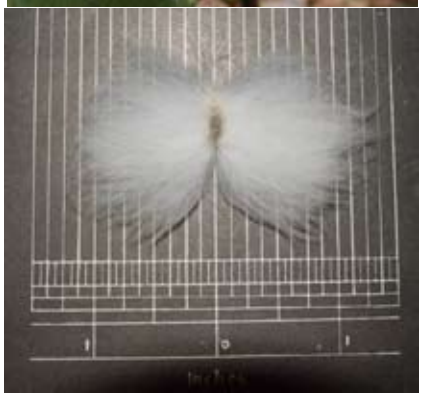
S.No.	Location	Upper Half Mean length (mm)	Bundle strength (g/tex)	Micronaire value (µg/inch)
1.	Banswara	27.3	25.5	3.9
2.	Talod	28.8	30.0	4.8
	Mean	**28.0**	**27.6**	**4.4**

Table 8a. Performance of TCH 1819 under closer spacing

Treatment	Plant height (cm)	No.of sympodia	Bolls / plant	Boll weight (g)	Seed cotton yield (kg/ha)
Spacing (M)					
M_1 - 100 x 10 cm (1,00,000 plants/ha)	90.5	13.66	17.72	4.47	**2063**
M_2 – 60 x 15 cm (1,11,111 plants/ha)	93.1	12.96	15.31	4.01	1947
M_3 – 75 x 30 cm (44,444 plants/ha)	87.3	15.15	20.50	4.33	1779
SEd.	-	0.54	1.35	0.15	70.4
CD(P=0.05)	NS	1.51	3.79	0.40	195.4

Table 8b. Performance of TCH 1819 under closer spacing with different fertilizer doses

Treatments	F_1 (100 % RDF)	F_2(125 % RDF)	F_3(150 % RDF)	Mean
S_1 – 100 x10 cm (1, 00,000 plants/ha)	2560	**3053**	2850	2821
S_2 – 100 x15 cm (66,666 plants/ha)	2060	2300	2275	2211
S_3 – 100 x 20 cm (50,000 plants/ha)	1490	1767	1743	1667
S_4–25/75 x15 cm (66,666 plants/ha)	1920	2220	2170	2103
S_5–25/75 x 30cm (33,333 plants/ha)	1970	2230	2250	2150
Mean	2000	2310	2258	
	SEd	CD (P =0.05)	CV %	
S	72	166	Main	7.0
F	42	88	Sub	5.3
S x F	106	NS		
F x S	95	NS		



COTTON - CO 17 (TCH 1819)

Table 9. Relative performance of cotton culture TCH 1819 for disease incidence in station trials screening

S. No	Genotypes	*Alternaria* leaf blight			Reaction	Root rot			Reaction
		2016-17	2017-18	Summer 2018		2016-17	2017-18	Summer 2018	
1.	TCH 1819	2	3	2	Moderately resistant	2	2	2	Moderately resistant
2.	Suraj	3	2	3	Moderately susceptible	2	2	2	Moderately resistant

Table 10. Relative performance of cotton culture TCH 1819 for leaf hopper incidence in station trial

S. No	Genotypes	Leaf hopper Injury Grade	Reaction
Centre : Coimbatore – MLT- Summer 2016			
1.	TCH 1819	II	Moderately resistant
2.	Suraj	IV	Highly Susceptible

Table 11. Detailed description of TCH 1819 as CO 17

Characteristics	Value	Characteristics	Value
Hypocotyl pigmentation	Present	Boll colour	Green
Days to flowering	53 days	Boll shape	Ovate
Stem pigmentation	Present	Boll surface	Pitted
Stem hairiness	Sparse	Boll prominence of tip	Point
Leaf shape	Palmate	Boll opening	Open
Leaf lobe number	5	Boll weight of seed cotton/ boll	Medium (4.0g)
Leaf size	Medium	Growth habit	Partially Determinate
Leaf colour	Green	Plant height	Medium (100 cm)
Leaf pubescence	Absent	Seed: Fuzz colours	White
Leaf appearance	Flat	100 seed weight (g)	Medium (9.0g)
Leaf gossypol glands	Absent	Fibrecolour	White
Leaf nectaries	Present	Fibre length (mm)	Medium (27.0 mm)
Leaf petiole pigmentation	Absent	Fibre strength (g/tex)	Strong (26.1)
Bract type	Normal	Fibre fineness (mic.)	Medium (4.0)
Bract number of serration	Medium	Fibre uniformity	Good (53.7)
Flower sepal pigmentation	Present	Fibre maturity (%)	Good (80%)
Petal colour	Cream	Ginning %	Medium (35%)
Petal spotting	Absent	Seed density of fuzz	Fuzzy
Position of stigma	Embedded	No. of monopodia/ plant	Nil (occasionally one Monopodia)
Filament colouration	Absent	Length of monopodia (cm)	Does not arise
Anther colour	Cream	No. of sympodia/ plant	18
Boll bearing habit	Solid	Length of sympodia (cm)	10.7
Boll size	Medium		

Under AICCIP evaluation trial, the culture was tested in Initial Evaluation Trial (IET) Br 06a compact trial during 2016-17 and in Coordinated Varietal Trial (CVT) during 2017-18. It has recorded an average seed cotton yield of 1850 kg/ha in five locations which was 37.9 per cent increase over check Suraj (1342 kg/ha) (**Table 5**).Full spinning test was assessed at CIRCOT Mumbai and the results were obtained by HVI mode. The culture TCH 1819 recorded Upper Half Mean Length (UHML) of 26.9 mm with bundle strength of 26.9 g/tex and micronaire value of 4.3 µg/inch (**Table 6**). Under AICCIP evaluation trial conducted during 2017-2018, this culture recorded UHML of 28.0 mm with fibre strength of 27.6g/tex and micronaire value of 4.4 µg/inch (**Table 7b**). This culture is designated under medium long staple length category with very strong fibre strength and can spin up to 40s'count. This culture

has the features of short stature, earliness, compactness, and short sympodia with synchronous boll opening. The synchronous bursting makes the crop amenable for mechanical harvesting and short sympodial length of this culture is highly suited for high density planting system. Spacing experiments and different doses of fertilizers under closer spacing were evaluated during 2015-16 and 2017-18 and this culture registered the highest seed cotton yield of 2063 kg/ha under the spacing of 100 x 10 cm with 125 % recommended dose of fertilizer (125%RDF) which was comparable with that of closer spacing of 60 x 15 cm (1947 kg/ha) (**Table 8a and 8b**). Kanchana *et al.* (2019) reported that under high density planting system, the genotype TCH 1819 performed better and obtained high yield with the application of 125 % RDF. The culture was found to be moderately resistant to *Alternaria* leaf blight and root rot. (**Table 9**) and moderately resistant to leaf hopper under summer irrigated conditions (**Table 10**).

The key morphological characters that distinguish this culture are compact and erect plant type with short sympodial branch. The complete description of TCH 1819 as per the DUS characters is presented in **Table 11**. Due to superiority over the checks Suraj and MCU 7 with higher seed cotton yield and good fibre quality traits, the culture TCH 1819 was proposed as a new variety as CO17 and is recommended for three different environments for cultivation *viz.,* rice fallow (Thanjavur, Thiruvarur and Nagapattinam), Winter rainfed (Perambalur, Dindigul, Madurai, Virudhunagar and Tuticorin) and Summer irrigated (Madurai, Theni and Virudhunagar) conditions of Tamil Nadu. The national identity of this variety is IC 633973.

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