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Using Yield Components to Genetically Improve Cotton

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GUEST COLUMN

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The evolution of cotton, Gossypium hirsutum L. may have occurred over a period of 10-20 million years (Wendel and Albert, 1992; Seelanan et al., 1997). Yet, improvements in yield have primarily been due to the influence of mankind in more recent times. The earliest cotton breeding efforts were likely those of the aboriginal groups who discovered a use for the coarse hairs covering the seed (Brubaker et al., 1999). Modern cotton breeding efforts began in the late 19th and early 20th centuries. After years of selection, by nature and man, G. hirsutum L. has been established as the primary cultivated cotton species.

Selection based upon yield components has long been considered a means to improve cotton yields. Over the last approximately 100 years, cotton breeders have seemingly come full circle in an attempt to identify appropriate cotton yield component selection criteria. Cook (1908) suggested that lint index (grams of fibre 100 per seed) could serve as an improved selection method over the commonly used lint percentage method. He proposed to select lines based upon the absolute weight of lint per seed, instead of the relationship of lint to seed. Over a period of time, selection for increased lint index resulted in increased lint per seed, accompanied by concurrent increased seed size.

Lint frequency, defined and used by Hodson (1920), measured the weight in grams of fibre of uniform length produced per cm2 of seed surface area. This method served to select for improved yield while normalising seed size. Thurman (1953) refined lint frequency with lint density index, which measured the weight of fibres per 100 cm2 seed surface area. The lint density index included all lint on seed, and removed the fibre length uniformity parameter used in determining lint frequency. Lint density index was positively correlated with lint percentage and lint index. Since lint percentage does not require an estimate of seed index or seed surface area, it has been widely used by most cotton breeding programs. Selection based upon lint percentage has led to increased lint yield, but has resulted in smaller seeded cultivars.

Breaux (1954) noted that the majority of cotton breeding programs were focusing on fibre quality improvement. Additionally, he observed that high lint density and small- to medium-sized seed offered the best possibility of obtaining high yielding lines. Mechanised harvest equipment provided a more efficient measurement of yield, and allowed breeding programs an opportunity to focus on lint yield improvement by directly measuring lint yield rather than yield components. In addition to harvested yield, multiple combinations of lint and fibre parameters have served as selection criteria. Among these, high lint percentage combined with an increased number of small- to medium-sized seeds has been the most utilised method (Miller and Rawlings 1967; Bridge et al. 1971; Culp and Harrell 1975; Harrell and Culp 1976).

Although attempts were made to utilise yield components, most of the early progress in cotton breeding was accomplished by visual selection for yield. A successful cotton breeder was often said to have "a good eye for cotton". Visual ratings for yield are still often used by breeders to advance lines, particularly in early generations. Breeding progress based upon visual ratings of yield may be limited to the cosmetic appearances of plants and bolls rather than actual yield. Plant structure may mask the yield performance of a line. As plant size increases, the ability to visually estimate yield becomes increasingly difficult. Similarly, boll conformation (size and degree of openness of boll) and orientation within the plant canopy can bias visual ratings. Selection based on harvested yields removes those biases. Yet, visual selection of plants and progeny rows is still essential in early generations because limited seed number may hinder plot size and/or yield testing of the large number of lines may not be practical.

Using data from cotton breeders in four different U.S. areas, Bowman et al. (2004) found correlations between visual ratings and actual yields ranged from -0.22 to 0.70. Breeders differed in their ability to visually select high yielding genotypes. Three individuals with cotton breeding experience (ranging from >30 years to >1 year) visually rated progeny rows in Arkansas. Correlations with harvested yield increased slightly with years of experience. Considering only visual ratings, all three individuals would have discarded the highest yielding progeny row in the test. These results verified the necessity of using harvested yield over visual observations, and suggested that yield improvement might be hindered if only visual observations were used to advance lines in early generations.

Harvested yield data have long been considered the optimum means to evaluate and select advanced lines in breeding programs. The development of mechanical pickers with on-board weigh systems have allowed breeders to increase the efficiency of obtaining yield measurements. This has enabled cotton breeders to evaluate yield of lines over multiple locations and years (environments) in an effort to improve yields. Yet, breeding progress based on yield is still hindered by high genotype by environment interactions (Bourland and Myers, 2015). If genotype by environment interactions did not play major roles in yield, improvement of cotton lines could be accomplished by simply selecting for high yields in one environment. Obviously, this has not occurred. Cotton lines are normally evaluated over many contrasting environments to ascertain their specific adaptation and to identify lines that are perform well over many environments (wide adaptation).

Early interest in yield components was likely engendered by the difficulty in obtaining plot yield data. Renewed interest in yield components has been associated with the desire to circumvent genotype by environment interactions and to achieve higher yield stability. Although cotton yield is highly sensitive to genotype by environment interactions, some components of yield may be less sensitive to these interactions. Modifying the basic components of cotton yield may provide a window to effectively select for improved yield efficiency. Most crop models define yield as the product of some determination of "number of seed per area" times the "weight per seed". "Number of seed per area" may be further extrapolated into interacting components of "number of plants per area", "number of bolls per plants" and "number of seed per boll". Determination of each of these components may be difficult and result in unexplained interactions and errors. Cotton plants primarily compensate for wide variation in

"number of plants per area" by varying the number of bolls per plant. Furthermore, cotton breeders should not be overly concerned whether "number of seed per area" are produced by higher "number of bolls per plant" or from "number of seed per boll". Thus, "number of seed per area" may be preferred as a yield component over its breakdown components.

In addition to "number of seed per area, the "weight of fibres per seed" must also be considered for cotton yield. Lewis et al. (2000) modelled cotton yield simply as the "number of seed produced per area" multiplied by the "weight of fibre per seed". Obviously, a high number of seed per area is required for high yields. However, over reliance on seed production for high yields leads to less stable yields because seed production requires more weight (seed makes up about 60% of seedcotton by weight) and energy (oil compared to cellulose production) than does lint production. Slight changes in the partitioning can result in significant lint yield increases. An increase of only 5 milligrams of fibre per seed produces about 95lb/acre (84 kg/ha) in lint yield. Furthermore, the "weight of fibre per seed" component eliminates many of the interactions that normally affect "number of seed per area" and lint yield (Groves and Bourland, 2016).

In addition to the ginning and fibre quality measurements normally available in cotton testing, the only other parameter needed to calculate these yield components is seed index (weight of 100 fuzzy seed). Seed surface area (SSA) can then be estimated by the regression equation suggested by Groves and Bourland (2010): SSA = 35.94 + 6.59SI, where SI is equal to seed index associated with the sample. "Weight of fibre per seed" and its related parameters "number of fibres per seed" and "fibre density" (number of fibres per unit area of seed coat) were much less affected by environment than were lint yield or number of seed per area (Groves and Bourland, 2016). Selection for high "weight of fibre per seed" alone results in lines with higher lint per seed, but also larger seed. In contrast, selection for high lint percentage will result in lines with higher gin turnout, but also smaller seed. They found that number of seed per area accounted for a minimum of 84% of the influence on lint yield. However, this trait exhibits low heritability and is highly dependent on environmental factors. Micronaire, fibres per seed and upper half mean length, all influenced the lint index. The greatest influence on lint index was from fibres per seed. Micronaire and upper half mean length had a negative relationship. Fibre density contributed a minimum of 68% of the influence on fibres per seed. These data suggested that fibre density could serve as selection criteria for increased yield and stability. In Australia, selecting for high fibre density has been an effective way to decrease fineness and micronaire while maintaining yield (Clement et al., 2014).

Higher yields tend to lead to less yield stability and lower fibre quality. Results from a multi-state, North Delta (U.S.A) study observed a low correlation between lint yield and yield stability (McNew et al., 2005, Bourland et al., 2005). Results of their study also showed a negative correlation between micronaire and stability, suggesting early maturing, high micronaire cultivars were more stable in yield performance. A weak positive correlation between number of fibre seed-1 (FPS) and fibre weight seed-1 as related to yield stability was also observed. Fibre length was negatively correlated with micronaire and FPS. Fibre length may influence other high volume instrument (HVI) fibre measurements including uniformity, strength and elongation (Smith and Coyle, 1997).

Negative relationships between yield and fibre quality traits have long restricted the genetic improvement of cotton. If this were not true, improvement in fibre quality would have accompanied recent improvements of yield. Using data from the U.S. (Regional High Quality Strain Test) and Australia, Clement et al. (2012) showed that negative associations still exist between yield and fibre quality. These negative associations were weaker in the Australian data than in the U.S. data. Bourland (2016) indicated that the negative relationship between lint yield and fibre quality for cultivars adapted to the U.S.A Mississippi River Delta Region has become less negative or perhaps neutral. Therefore, cotton breeders should be able to more easily identify and develop lines that provide both high yield and high fibre quality. Further improvements in cotton yield (via yield components) and fibre quality will enhance the cotton industry throughout the world.

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Courtesy : Cotton India 2016-17

(The views expressed in this column are of the author and not that of Cotton Association of India)

ICAC Forecasts that World Production Will Grow by 2% in 2017/18

In its first estimate of the 2017/18 crop, the ICAC predicts that world cotton output will rise by 2% to 23.4 million tons. The expansion is the result of an increase in planted area, which is expected to grow by 5% to 30.6 million hectares after two seasons of contraction. After improving by 13% to 781 kg/ha in 2016/17, the world average yield is projected to decline by 2% to 764 kg/ha, which is in line with the 4-year average.

In 2016/17, the cotton area in India, the largest cotton-producing country, fell by 12% to 10.5 million hectares due to competition from food crops. However, the average yield recovered by 16% to 560 kg/ha, due to more favorable monsoon conditions than in the two previous seasons. As a result, production in 2016/17 is estimated to rise by 2% to 5.9 million tons. In 2017/18, India's area is forecast to recover by 7% to 11.2 million hectares as firm domestic cotton prices and less attractive prices for competing crops attract more farmers to cotton. Assuming a national average yield of 530 kg/ha that is similar to the 5-year average, production will increase by 1% to 6 million tons.

Cotton area in China declined for five consecutive seasons, reaching 2.8 million hectares in 2016/17 due to high production costs for cotton and better returns for competing crops. However, output has not fallen as quickly due to the fact that the share of cotton grown in Xinjiang, which has higher yields than other producing regions in China, has increased considerably. China's cotton production in 2016/17 is estimated at 4.7 million tons. In 2017/18, China's cotton area may expand by 3% to 2.9 million hectares, as cotton prices become more attractive than those of competing crops. Assuming a yield of 1,640 kg/ha, cotton output in China could reach 4.8 million tons in 2017/18.

Following a season of higher than expected yields and firm cotton prices, cotton area in the United States is expected to expand by 10% to 4.2 million hectares in 2017/18. The average yield in the United States improved by 12% to 958 kg/ha in 2016/17 due to beneficial weather and plentiful rains during the growing seasons. Output is estimated at 3.7 million tons. In 2017/18, production in the United States is projected to rise by 7% to 4 million tons, assuming an average yield of 935 kg/ha.

A significant drop in yields and poor returns in 2015/16 led to a 12% decrease to 2.5 million hectares in Pakistan's cotton area in 2016/17. The average yield recovered by 32% to 699 kg/ha and output is estimated up by 17% to 1.8 million tons. Pakistan's cotton area is forecast to increase by 3% to 2.6 million hectares as better yields and firm cotton prices encourage farmers to plant more cotton. Assuming a yield of 739 kg/ha, Pakistan's production could reach 1.9 million tons.

World cotton mill use is expected to remain stable at 24.1 million tons in 2016/17 as high cotton prices discouraged growth in demand. However, mill use may expand by 1% to 24.3 million tons in 2017/18. Mill use in the top three consuming countries, China, India, and Pakistan, is expected to remain unchanged from 2016/17. However, mill use is forecast to grow in Turkey, Bangladesh, and Vietnam by 2% to 1.5 million tons, by 5% to 1.5 million tons, and by 7% to 1.2 million tons, respectively.

Given the continued growth in mill use in countries that depend on imports, world cotton trade is projected to increase by 5% to 8.2 million tons in 2017/18 from 7.8 million tons in 2016/17. Bangladesh is likely to maintain its position as the world's largest importer of cotton with its volume forecast to rise by 5% to 1.5 million tons. Vietnam's import volume is projected to grow by 8% to 1.3 million tons, making it the world's second largest importer. Given the gap between production and consumption expected in 2017/18 and the reduction in stocks from previous seasons, China's imports may increase by 15% to 1.1 million tons, assuming additional quota is allowed in 2018. Given the large exportable surplus and strong demand, exports from the United States are anticipated to rise by 17% to 3.2 million tons in 2017/18. India's exports are forecast to fall by 7% to 875,000 tons in 2017/18.

World cotton stocks are expected to decline by 6% at the end of 2016/17 to 18.1 million tons as China reduces its stocks by 17% to 9.3 million tons. However, stocks outside of China are projected to increase by 8% to 8.8 million tons or 36% of mill use in 2016/17.

Source: International Cotton Advisory Committee, Cotton This Month, February 1, 2017.

Supply and Distribution of Cotton

February 1, 2017

Seasons begin on August 1 — Million Metric Tons

	2012/13	2013/14 Est.	2014/15 Est.	2015/16 Est.	2016/17 Proj.	2017/18 Proj.
BEGINNING STOCKS						
WORLD TOTAL	**15.363**	**18.500**	**20.596**	**22.324**	**19.25**	**18.02**
China	6.181	9.607	12.109	12.917	11.16	9.27
USA	0.729	0.903	0.651	0.980	1.05	1.32
PRODUCTION						
WORLD TOTAL	**26.777**	**26.170**	**26.197**	**21.074**	**22.85**	**23.39**
India	6.290	6.766	6.562	5.746	5.88	5.96
China	7.300	6.950	6.500	4.753	4.74	4.81
USA	3.770	2.811	3.553	2.806	3.69	3.96
Pakistan	2.002	2.076	2.305	1.514	1.77	1.92
Brazil	1.310	1.734	1.563	1.289	1.42	1.34
Uzbekistan	1.000	0.910	0.885	0.832	0.77	0.75
Others	5.105	4.924	4.829	4.134	4.58	4.66
CONSUMPTION						
WORLD TOTAL	**23.780**	**24.004**	**24.445**	**24.131**	**24.08**	**24.29**
China	8.290	7.517	7.479	7.442	7.59	7.59
India	4.731	5.057	5.261	5.243	5.09	5.11
Pakistan	2.216	2.470	2.492	2.256	2.27	2.28
Europe & Turkey	1.560	1.611	1.692	1.687	1.63	1.66
Bangladesh	1.023	1.146	1.204	1.324	1.40	1.47
Vietnam	0.492	0.673	0.875	1.007	1.14	1.22
USA	0.762	0.773	0.778	0.751	0.72	0.72
Brazil	0.910	0.862	0.797	0.733	0.70	0.68
Others	3.795	3.895	3.866	3.689	3.55	3.57
EXPORTS						
WORLD TOTAL	**10.061**	**9.005**	**7.803**	**7.553**	**7.76**	**8.17**
USA	2.836	2.293	2.449	1.993	2.71	3.17
India	1.685	2.014	0.914	1.255	0.94	0.87
CFA Zone	0.828	0.973	0.893	0.989	1.01	1.10
Brazil	0.938	0.485	0.851	0.939	0.66	0.68
Uzbekistan	0.690	0.615	0.550	0.543	0.43	0.42
Australia	1.343	1.057	0.520	0.616	0.85	0.81
IMPORTS						
WORLD TOTAL	**10.201**	**8.935**	**7.781**	**7.540**	**7.76**	**8.17**
Bangladesh	1.044	1.190	1.177	1.355	1.40	1.47
Vietnam	0.517	0.687	0.934	1.001	1.19	1.29
China	4.426	3.075	1.804	0.959	0.98	1.13
Turkey	0.803	0.924	0.800	0.918	0.89	0.95
Indonesia	0.686	0.651	0.728	0.640	0.67	0.68
TRADE IMBALANCE 1/	0.140	-0.070	-0.022	-0.013	0.00	0.00
STOCKS ADJUSTMENT 2/	0.001	0.000	-0.002	-0.005	0.00	0.00
ENDING STOCKS						
WORLD TOTAL	**18.500**	**20.596**	**22.324**	**19.249**	**18.02**	**17.13**
China	9.607	12.109	12.917	11.160	9.27	7.59
USA	0.903	0.651	0.980	1.049	1.32	1.39
ENDING STOCKS/MILL USE (%)						
WORLD-LESS-CHINA 3/	**57**	**51**	**55**	**48**	**53**	**57**
CHINA 4/	**116**	**161**	**173**	**150**	**122**	**100**
COTLOOK A INDEX 5/	**88**	**91**	**71**	**70**		

1/ The inclusion of linters and waste, changes in weight during transit, differences in reporting periods and measurement error account for differences between world imports and exports.

2/ Difference between calculated stocks and actual; amounts for forward seasons are anticipated.

3/ World-less-China's ending stocks divided by World-less-China's mill use, multiplied by 100.

4/ China's ending stocks divided by China's mill use, multiplied by 100.

5/ U.S. Cents per pound

(Source : ICAC Cotton This Month, February 1, 2017)

COTTON EXCHANGE MARCHES AHEAD

Madhoo Pavaskar, Rama Pavaskar

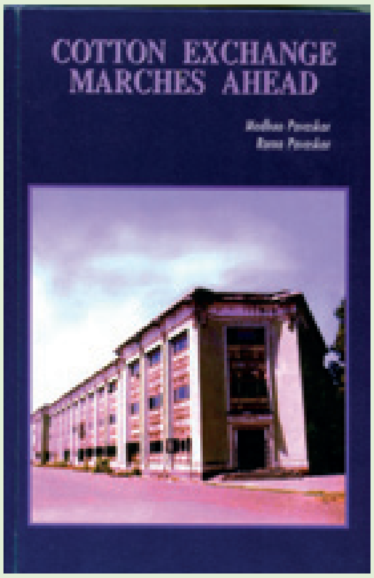
Chapter 3

Raising Cotton Productivity

(Contd. from Issue No.45 …….)

Production of Certified Seeds

Although the supply of hybrid seeds and of improved varieties match the demand for them, only about 60 per cent of the cotton cultivated area in the country is planted with hybrid and improved varieties. The rest is sown with either seeds retained by the farmers from their own production, or 'market seeds'. Market seeds are cotton seeds sold by ginners. With small cotton farms, cotton merchants and ginners buy seed cotton from several farmers and mix the produce for ginning. The mixing of produce of different varieties results in mixing of seeds of those varieties, which are eventually sold as market seeds to farmers. Such seeds are necessarily of mixed genetic purity and quality, and tend to affect adversely the output and quality of both kapas and cotton lint. Hence, one of the constraints for improving cotton productivity and quality in India is the non-availability of genetically pure, certified/truthful label seeds in adequate quantities.



COTAAP is aware that it is not easy to overcome this constraint. For one thing, the requirement of certified or truthfully labelled seeds is so large that it extends to almost 40 per cent, or even more, of the cotton farmers, dispersed over many cotton growing regions in the country. For the other, the task of maintaining purity of seeds over successive generations is compounded by the present structure of cotton production sector in India, which is dominated by tiny farms and small farmers who prefer to use market seeds of mixed purity due to their low price. Many of them cannot afford to buy more costly certified or truthfully labelled seeds. It is essential to provide genetically pure seeds at reasonable prices on the doorsteps of small farmers, a task which only the public sector seed corporations and the State agricultural departments can undertake.

Nevertheless, to make a small dent in this gigantic problem, COTAAP initiated in 1995-96 a modest seed production experiment on a cultivator's farm at village Panjari Lodhi in Nagpur district of Maharashtra. Using certified foundation seeds, it embarked on an experimental basis the production of truthful label seeds of LRA-5166 variety, a high yielding superior medium staple cotton popular among the cultivators in the central zone and also in good demand. The selection of Vidarbha region of Maharashtra was quite appropriate, as it is characterised by small farms with unusually low yields. The experiment continued in the following years with the production of certified seeds of the superior-medium staple cotton variety, Anjali (LRK-516), over 20 hectare land belonging to three farmers at the same location. Although these efforts have, of late, been discontinued, once its resources improve, COTAAP proposes to develop this activity on a far more enlarged scale.

Programmes in Karnataka

Beginning with the 1997-98 cotton season, COTAAP initiated the Model Cotton Development Farm and Cotton Extension Service programmes around Raichur in Karnatka in the same manner as it had carried out similar programmes earlier at Sriganganagar in Rajasthan. The cotton area around Raichur was selected as it comes under the Tungabhadra Dam Project. Two areas – one in Kasbe Camp and the other in village Kallur – were identified for the model cotton farm, where the improved hybrid cotton DHH-11 was being cultivated. To resolve effectively the vexed problem of pest attack encountered in the area, integrated pest management (IPM) technology for crop protection was emphasised at both the model cotton farms to bring down the cost of cultivation by as much as RS 3000/- per acre. The programmes were undertaken with the active support of the Gunj Merchants' Association, Raichur, and the cotton scientists of Agricultural College and Research Station under the University of Agricultural Sciences, Dharwar.

Under the cotton extension service programme, covering a much wider area around Raichur,

pamphlets outlining appropriate suggestions and guidance for raising a good cotton crop with high yields were prepared in Kannada and Telugu and distributed among the local farmers. The field staff of the Service Centre of COTAAP also rendered extension services to the cotton growers in Kasbe Camp and the adjoining Kallur village. The yield of seed cotton per acre in the area covered by the extension service of COTAAP was on an average 8-9 quintals, compared to 7 quintals or less in the surrounding areas during 1997-98.

COTAAP continued successfully its activities in Raichur district during 1998-99 and 1999-2000. The main objective of these programmes, extended on both the model farms and areas covered by the extension service, was to demonstrate to the cotton growers as to how the incidence of insects-pests could to kept within the cost effective economic bounds by treating the seeds, releasing parasites on the plots, using bio-pesticides, monitoring insect population by laying pheromone traps, etc. , instead of spraying heavy doses of costly chemical pesticides indiscriminately. Overall, COTTAAP demonstrated to the Raichur farmers that using IPM practices and with just about 8-10 need based sprays of chemical pesticides (as against as many as 20-25 sprays resorted to earlier), optimum yields could be obtained.

Soon after the dawn of the New Millennium, for the cotton season 2001-02, village Nellhal – about 18 km from Raichur was selected. Two farmers from the village released small plots of their cotton acreage for model cotton farms. The selected farmers agreed to follow the methods of cultivation, integrated pest management technology and other crop practices as recommended by the COTAAP scientists. COTAAP reimbursed 50 per cent of the seed cost and full cost of pesticides used on the model farms, besides monitoring the cultivation practices and providing regular and timely guidance.

The two model farms at Nellhal village serve essentially as demonstration fields for the farmers in the neighbourhood cultivating cotton over almost 4000 hectares. As in its programmes pursued earlier elsewhere, COTAAPoffers elaborate extension services to the cotton farmers surrounding the model farms and provides the requisite advice for raising a good cotton crop. COTAAP also organises in the villages selected for model farms, Farmers' Day programmes every year to explain to the farmers the benefit of adopting IPM methods and modern production technologies for realising higher yields with lower costsin growing better quality cotton.

Other Activities of COTAAP

Despite its limited resources, COTAAP is engaged in several other activities for the benefit of the cotton economy. Thus, the pictorial poster campaign to educate the owners and workers in the ginning and pressing factories so as to bring about quality improvement in cotton processing (elaborated in the previous chapter) was primarily undertaken by the COTAAP Foundation. COTAAP has also been sponsoring eminent Indian cotton scientists to enable them to attend and participate in major international conferences and workshops on technical issues related to cotton.

This is not all. The Cotton Exchange, in association with its COTAAP Research Foundation, has been organizing periodically seminars and workshops on various issues pertaining to cotton farming and productivity. Eminent scientists from different cotton disciplines, technocrats and other experts from the government and public sector organizations are invited to present papers and participate in the deliberations of such seminars and workshops. The underlying objective of these meetings of experts and scientists is not only to exchange information on the new developments in cotton research, but, more imporatantly, to identify the various constraints faced in improving cotton productivity and to suggest suitable remedial measures. These fora have proved extremely useful in disseminating latest advances in cotton research.

Looking Ahead

Beginning cautiously on a modest scale in the early nineties after it acquired the minimum requisite wherewithal, the COTAAP Research Foundation has slowly diversified its activities in different directions over selected cotton growing areas in recent years. With the envisaged growth in cotton production and consumption, and consequently also in the private sector's share in domestic and export marketing of kapas and cotton lint, the corpus fund of COTAAP may well be expected to swell in the coming years by more liberal contributions from cotton merchants and mills, especially after the futures market of the Cotton Exchange attracts large volumes. When that happens, COTAAP may be expected to expand its programmes for improving cotton productivity manifold from the present modest level. That day may surely dawn in the near future to enable the Cotton Exchange to march still ahead.

UPCOUNTRY SPOT RATES

(Rs./Qtl)

Standard Descriptions with Basic Grade & Staple in Millimetres based on Upper Half Mean Length [By law 66 (A) (a) (4)]							Spot Rate (Upcountry) 2016-17 Crop FEBRUARY 2017					
Sr. No.	Growth	Grade Standard	Grade	Staple	Micronaire	Strength /GPT	6th	7th	8th	9th	10th	11th
1	P/H/R	ICS-101	Fine	Below 22mm	5.0-7.0	15	9139 (32500)	9111 (32400)	9111 (32400)	9139 (32500)	9336 (33200)	9392 (33400)
2	P/H/R	ICS-201	Fine	Below 22mm	5.0-7.0	15	9420 (33500)	9392 (33400)	9392 (33400)	9420 (33500)	9617 (34200)	9673 (34400)
3	GUJ	ICS-102	Fine	22mm	4.0-6.0	20	9111 (32400)	9055 (32200)	9055 (32200)	9055 (32200)	9055 (32200)	8998 (32000)
4	KAR	ICS-103	Fine	23mm	4.0-5.5	21	9926 (35300)	9870 (35100)	9870 (35100)	9870 (35100)	9870 (35100)	9814 (34900)
5	M/M	ICS-104	Fine	24mm	4.0-5.0	23	10882 (38700)	10826 (38500)	10826 (38500)	10826 (38500)	10826 (38500)	10826 (38500)
6	P/H/R	ICS-202	Fine	26mm	3.5-4.9	26	11979 (42600)	11923 (42400)	11838 (42100)	11923 (42400)	12063 (42900)	12204 (43400)
7	M/M/A	ICS-105	Fine	26mm	3.0-3.4	25	10939 (38900)	10882 (38700)	10882 (38700)	10911 (38800)	11023 (39200)	11107 (39500)
8	M/M/A	ICS-105	Fine	26mm	3.5-4.9	25	11332 (40300)	11276 (40100)	11276 (40100)	11304 (40200)	11417 (40600)	11501 (40900)
9	P/H/R	ICS-105	Fine	27mm	3.5.4.9	26	12148 (43200)	12092 (43000)	12007 (42700)	12092 (43000)	12232 (43500)	12373 (44000)
10	M/M/A	ICS-105	Fine	27mm	3.0-3.4	26	11051 (39300)	10995 (39100)	10995 (39100)	11023 (39200)	11135 (39600)	11220 (39900)
11	M/M/A	ICS-105	Fine	27mm	3.5-4.9	26	11557 (41100)	11501 (40900)	11501 (40900)	11529 (41000)	11642 (41400)	11726 (41700)
12	P/H/R	ICS-105	Fine	28mm	3.5-4.9	27	12232 (43500)	12176 (43300)	12092 (43000)	12176 (43300)	12317 (43800)	12457 (44300)
13	M/M/A	ICS-105	Fine	28mm	3.5-4.9	27	11698 (41600)	11642 (41400)	11642 (41400)	11670 (41500)	11782 (41900)	11867 (42200)
14	GUJ	ICS-105	Fine	28mm	3.5-4.9	27	11782 (41900)	11726 (41700)	11726 (41700)	11754 (41800)	11867 (42200)	11951 (42500)
15	M/M/A/K	ICS-105	Fine	29mm	3.5-4.9	28	11782 (41900)	11726 (41700)	11726 (41700)	11754 (41800)	11867 (42200)	11951 (42500)
16	GUJ	ICS-105	Fine	29mm	3.5-4.9	28	11867 (42200)	11810 (42000)	11810 (42000)	11838 (42100)	11951 (42500)	12035 (42800)
17	M/M/A/K	ICS-105	Fine	30mm	3.5-4.9	29	11951 (42500)	11895 (42300)	11895 (42300)	11923 (42400)	12035 (42800)	12120 (43100)
18	M/M/A/K/T/O	ICS-105	Fine	31mm	3.5-4.9	30	12176 (43300)	12120 (43100)	12120 (43100)	12148 (43200)	12260 (43600)	12345 (43900)
19	A/K/T/O	ICS-106	Fine	32mm	3.5-4.9	31	12260 (43600)	12260 (43600)	12260 (43600)	12288 (43700)	12401 (44100)	12485 (44400)
20	M(P)/K/T	ICS-107	Fine	34mm	3.0-3.8	33	15635 (55600)	15635 (55600)	15635 (55600)	15635 (55600)	15635 (55600)	15635 (55600)

(Note: Figures in bracket indicate prices in Rs./Candy)