

# COTTON Innovate



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## Cotton QTLdb: A QTL database for Marker Assisted Selection in Cotton

H. B. Santosh and K. P. Raghavendra, Scientists, CICR, Nagpur

Cotton is the most important cash crop with significant influence on global economy and farmers' prosperity. Improving the lint yield, fibre quality, biotic and abiotic stress tolerance are the main objectives of cotton breeding programmes. Majority of these traits of economic importance are governed by multi-factorial polygenes or Quantitative Trait Loci (QTL) having lower heritability and whose expression is greatly affected by the environmental factors. Crop improvement by conventional breeding where selection is primarily depends on phenotype is often not rewarding as breeders commonly confront with the problem of genotype  $\times$  environment interactions. Hence, conventional breeding needs to be complimented with modern molecular approaches to achieve higher breeding gains.

File	Map	QTL	Chromosome	Trait	LOD	R-sq	SimMap	Position	Left	Right
upland	consensusmap	BN1.w	3	BN	3.47	6.33	N	0.01	0	7.22
upland	consensusmap	QTLBN1.d	3	BN	2.42	16.1	N	43.5	0	54
upland	consensusmap	BN-3	3	BN	3.53	3.93	N	74.975	69.975	79.975
upland	consensusmap	qNB-A4-1	4	BN	2.05	5.2	N	7	0	10.6
upland	consensusmap	BN-5	5	BN	3.45	3.64	N	182.215	177.215	187.215

The term Quantitative Trait Locus (QTL) was first coined by Gelderman (1975) which defines QTL as “a region of the genome that is associated with an effect on a quantitative trait”. The continuous variation in trait expression may be controlled by many genes (a few hopefully of *large effect* and the others of *small effect*), but affected by genetic (*gene  $\times$  gene interaction; epistasis*) and non-genetic factors [*macro- and micro-environment variations and measurement errors (Noise)*] apart from their interaction with the environment (*gene  $\times$  environment interaction*). QTL mapping identifies a genetic marker that tends to co-segregate with the trait, where we seek a statistically significant association between marker alleles (genotypes) and trait values (phenotypes) using a *mapping population* (Linkage analysis) or a *natural/breeding population* (Association analysis) approach.

A plethora of QTLs (>1500) have been mapped in cotton genome for different traits of economic importance, mainly using bi-parental, intra- and inter-specific mapping populations. But, the inherent limitations associated conventional QTL analysis has hindered their practical application in plant breeding. To circumvent this, linkage disequilibrium based association mapping approach is being attempted to identify the QTLs which can work across populations (Abdurakhmonov *et al.*, 2008; Fang *et al.*, 2013). Recently, Said *et al.* (2013) has identified many QTL clusters and hotspots by surveying over 1200 QTLs from 42 different QTL studies using Meta-QTL analysis. Meta-analysis studies (Rong *et al.*, 2007; Lacape *et al.*, 2010 and Said *et al.*, 2014) quickly became obsolete as succeeding QTL studies were published. Hence, there was a need for a specialized, regularly updatable, functional database to provide all the needed information about cotton QTLs to serve as resource tool for cotton community and to marker assisted cotton breeding programs.

In this regard, a dedicated cotton QTL database has been developed by Said *et al.* (2015) which is called **Cotton QTLdb**, accessible at <http://www.cottonqtl.org>. The current Cotton QTLdb database (Release 1) covers 2274 QTLs from 92 publications covering 66 different QTL trait types related to fiber quality, drought tolerance, hairiness, morphological traits, phenology, physiological traits, resistance, seed quality, yield and yield component traits. Hence, it represents the most recent and comprehensive QTL data gathered spanning 16 years of research since 1998. Cotton QTLdb allows visualization of previously identified QTLs and submission of new QTLs to the database. This database comes with an option of selecting various QTL trait types from either the *G. hirsutum* or *G. hirsutum* × *G. barbadense* populations. Based on the user's QTL trait selection, graphical representations of chromosomes are displayed along with the statistical data [LOD scores, phenotypic variance ( $R^2$ ), confidence interval, position of the QTL determined by the original study] for each QTL. All data and tools are hosted on an Amazon cloud server and managed by the Cotton Breeding and Genetics research group at New Mexico State University. Cotton QTLdb has been designed to work optimally on Google Chrome or Mozilla Firefox browsers.

Database homepage contains information about the Cotton QTL database and references. '**Trait Descriptions**' option will take the user to a table which contains a complete list of the traits found in the database along with description of each trait. '**Data Sources**' option presents complete list of publications which have contributed QTL data to the database. '**QTL Search**' is the main tool of the database which takes the user to a screen that gives the user an option to load their own QTL data in excel format, or continue to the trait selection screen. From the trait selection screen, specific traits and populations can be selected. QTLs are displayed in tabular format revealing the QTL name, chromosome number, LOD score,  $R^2$ , position, and confidence intervals for all the selected traits. User has a valuable option to select the markers tightly linked to QTLs by choosing appropriate distance (centimorgans; cM) of his own choice. Once the distance of choice is given, database will provide chromosome-wise graphical display of QTLs along with the markers present within the specified distance from the QTL. '**Data Submission**' contains information necessary for the user to submit their QTL data to the database. This enables addition of new QTLs to the currently available 2274 QTLs by the members of the cotton community hence, keeping it relevant and updated in years to come. Cotton QTLdb allows the user to make an informed decision about the most important markers to be focused on in their study. The identified tightly linked marker(s) can be targeted for QTL(s) introgression to achieve accelerated development of cultivars using marker assisted breeding. A QTL search steps for finding the markers linked to QTL governing boll number in cotton is presented below as an example.

#### References:

- Said JI, Knapka JA, Song M, Zhang J (2015) Cotton QTL Database: A tool for QTL analysis, visualization, and comparison between *Gossypium hirsutum* and *G. hirsutum* × *G. barbadense* populations. *Molecular Genetics and Genomics*. 290:1615–1625
- Said JI, Song M, Wang H, Lin Z, Zhang X, Fang DD, Zhang J (2014) A comparative Meta- analysis of QTL between intraspecific *Gossypium hirsutum* and interspecific *G. hirsutum* × *G. barbadense* populations. *Molecular Genetics and Genomics* 290(3):1003-25.
- Said JI, Lin Z, Zhang X, Song M, Zhang J (2013) A comprehensive Meta QTL analysis for fiber quality, yield, yield related and morphological traits, drought tolerance, and disease resistance in tetraploid cotton. *BMC Genomics* 14:776

## Brainstorming Session on whitefly

Dr Dilip Monga and Dr Rishi Kumar participated in "Brainstorming session on whitefly" at Regional Research Station, Punjab Agricultural University, Bathinda on 1st Sept, 2015. The session was chaired by Dr B. S. Dhillon, Vice chancellor, Punjab Agricultural University, Ludhiana and scientists from State Agricultural Universities (HAU Hisar, ARS RAU Ganganagar & PAU, Ludhiana) & KVKs of Punjab participated in the session. Dr D. Monga appraised the gathering about the present scenario of whitefly and CLCuD in the zone and the efforts of CICR. Interactions with respect to whitefly were held for immediate and long term action plan.



## ICAR-CICR Initiates Mera Gaon Mera Gaurav Programme

ICAR- CICR initiates implementations of the 'Mera Gaon Mera Gaurav' Programme and finalised team of scientists; each team comprises of four scientists and selected five cluster villages as per guidelines. The lists of scientist's team and villages adopted at Nagpur; Regional Stations Coimbatore and Sirsa are as follows.

**Mera Gaon Mera Gaurav**

**"मेरा गांव मेरा गौरव"**

### Activities

- Strengthen interface with farmers
- Update farmers on agro-practices
- Provide technology hand-out as per the agro-ecological conditions of the village
- Provide information on inputs, climate and markets
- Education through radio, newspapers
- Create awareness among farmers about the programmes being implemented by various organisations and institutions working at local level
- Spread awareness about Swachh Bharat Abhiyaan, climate change, water conservation, soil fertility, etc
- Organise farmers' meets with institute specialists
- Identify technical problems at village level and make use of those in prospective research programmes
- Submit quarterly reports on technical, social and economic data generated

**Nodal Officer: Dr S. M. Wasnik, Principal Scientist, Extension**

Team	Name of Scientists	Designation	Villages Adopted
<b>CICR, Nagpur, Maharashtra</b>			
1.	Dr. Sunil Rokde	Principal Scientist	<b>Ganeshpur cluster, Wardha</b> Villages: Ganeshpur; Digras; Zadgaon; Belgaon; Borgaon (Sawli)
	Dr. Punit Mohan	Principal Scientist	
	Dr. G. Balasubramani	Principal Scientist	
	Dr. J. H. Meshram	Scientist	
2.	Dr. R. B. Singandhupe	Principal Scientist	<b>Parseoni cluster, Nagpur</b> Villages: Narhar; Kolutmara; Nehra; Banera; Dhawalapur
	Dr. P. R. Vijyakumari	Principal Scientist	
	Dr. T. R. Loknathan	Principal Scientist	
	Dr. K. P. Raghavendra	Scientist	
3.	Dr. Nandini Narkhedkar	Principal Scientist	<b>Girad cluster, Wardha</b> Villages: Jogingumpha; Shivanphal; Arvi; Faridpur; Mohgaon
	Dr. M. Saravanan	Scientist	
	Dr. Shailesh Gawande	Scientist	
	Dr. Joy Das	Scientist	
4.	Dr. S. M. Palve	Principal Scientist	<b>Nandura cluster, Wardha</b> Villages: Nandura; Nagapur; Karanji (Bhoge); Karanji (Kaji); Pujai
	Dr. M. V. Venugopalan	Principal Scientist	
	Dr. V. Santhy	Senior Scientist	
	Dr. V. S. Nagrare	Senior Scientist	
5.	Dr. V. N. Waghmare	Principal Scientist	<b>Hingna cluster, Nagpur</b> Villages: Mangali; Mandavghorad; Junewani; Nanda Khurd; Ukhali
	Dr. H. B. Santosh	Scientist	
	Dr. Rakesh Kumar	Scientist	
	Dr. Savitha Santosh	Scientist	
6.	Dr. S. B. Nandeshwar	Principal Scientist	<b>Godhani cluster, Umred, Nagpur</b> Villages: Godhani; Mhasala; Mohpa; Sukali; Telkavads
	Dr. Vinita Gotmare	Principal Scientist	
	Dr. A. Manikandan	Scientist	
	Dr. Prabhulinga T.	Scientist	
7.	Dr. A. R. Raju	Principal Scientist	<b>Kasimeshwar cluster, Nagpur</b> Villages: Sonegaon; Pohi; Ladai; Linga; Uparwahi
	Dr. J. Amudha	Senior Scientist	
	Er. G. Majumdar	Scientist	
	Dr. Anuradha Narala	Scientist	
8.	Dr. D. V. Patil	Senior Scientist	<b>Navegaon cluster, Umred, Nagpur</b> Villages: Navegaon Sadhu; Tirkhura; Karhandla; Thana; Sev
	Dr. Sunil Mahajan	Senior Scientist	
	Dr. Chinna babu Naik	Scientist	
	Dr. Annie Sheeba	Scientist	

<b>CICR- Regional Station, Coimbatore, Tamil Nadu</b>			
1.	Dr. N. Gopalakrishnan-	Principal Scientist	<b>Vadapudur Panchayat, Kinathukadavu block , Coimbatore</b> Villages: Vadapudur; Singaiyanpudur; Sikkalampalayam; Yelur; Kallapuram
	Dr. K.P.M. Damayanthi	Principal Scientist	
	Dr. K. Sankaranarayanan	Principal Scientist	
	Dr. Isabella Agarwal	Principal Scientist	
2.	Dr. K. Rathinavel-	Principal Scientist	<b>Sokkanur panchayat, Kinathukadavu block, Coimbatore</b> Villages: Sokkanur; Muthugoundanpudur Palapathy; Veerappagoundanur; Venkaiyagoundanpudur
	Dr. M. Amutha	Scientist	
	Dr. C. Karpagam	Senior Scientist	
	Dr. M. Sabesh	Scientist	
3.	Dr. P. Nalayini	Principal Scientist	<b>Kanjapalli Panchayat, Annur Block, Coimbatore</b> Villages: Kanjapalli; Dhasarpalayam; Oothupalayam; Kumaragounderpudur; Neelagoundarpudur
	Dr. S. Manickam	Principal Scientist	
	Dr. D. Kanjana	Scientist	
	Dr. J. Gulsarbanu	Principal Scientist	
4.	Dr. S.E.S.A.Khader	Principal Scientist	<b>Allapalayam Panchayat, Annur Block, Coimbatore</b> Villages: Allapalayam; Konarpalayam; Uthirampalayam; Mathireddypalayam; Akravachengapalli
	Dr. B. Dharajothi	Principal Scientist	
	Dr. R. Raja	Senior Scientist	
	Dr. S. Usha Rani	Senior Scientist	
	Dr. Manivannan	Scientist	
<b>CICR- Regional Station, Coimbatore, Sirsa, Haryana</b>			
1.	Dr O.P.Tuteja	Principal Scientist	<b>Sirsa</b> Villages: Jhonpra; Alleekan; Nejadela Kalan; Rangari; Begu
	Dr. R.A.Meena	Principal Scientist	
	Dr. S.K.Verma	Principal Scientist	
	Dr. Rishi Kumar	Principal Scientist	



## CICR Scientists visited cotton fields of Korpana, Chandrapur

The multidisciplinary team of scientists comprising of Dr. Jayant Meshram (Plant Physiology), Dr. Chinna Babu Naik (Entomology), Dr. Shailesh Gawande (Plant Pathology) and Dr. A. Manikandan (Soil Science) from ICAR-Central Institute for Cotton Research, Nagpur along with officials from State Agriculture Department, Maharashtra visited villages of Korpana Tehsil, district Chandrapur on 27 August, 2015 for assessing wilting problem in cotton fields. As per SDAO, Korpana Tehsil, over 150-200 acres of standing crop in Korpana Tehsil was under prolonged hot-dry spell, variation in temperature and nutrients imbalance resulted in leaf reddening and wilting. Use of nutrients and pesticides beyond expiry date cause the chemicals to chelate. Use of such chemicals on a stressed plant has caused the symptoms that include yellowing of leaves followed by leaf-reddening and finally drying of leaves (wilting). It was noticed that the Bt cotton hybrids were sown in the second week of June, 2015 under rainfed conditions. Farmers have first observed these symptoms in the 2<sup>nd</sup> week of July under rainfed conditions.



Scientist- Farmer Interaction



Leaf reddening due to abiotic stress



Field view of leaf reddening



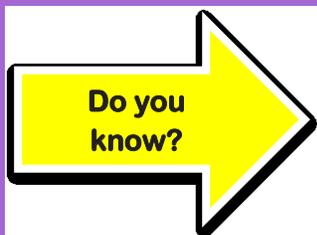
Scientist- Farmer Interaction



Field view



Field view



**The cotton gin revolutionized the cotton industry in the 18<sup>th</sup> century, and allowed cotton growers to supply larger amounts of cotton fiber each year to the growing textile industry**

**U.S. paper money is not actually made of paper; it's actually a blend of 75% cotton and 25% linen.**

## FAREWELL

Shri. K.G. Dewale, Chief Technical Officer (T-9), Shri. G.R. Kene, Technical Officer (T-5), Shri. Prakash Mishra, Technical Officer (T-5), Shri. A.D. Belsare, Technician (T-1) and Shri. H.Z. Sawalkar, Skilled Support Staff were accorded warm farewell on 31<sup>st</sup> August, 2015 on behalf of staff welfare club. Dr. K. R. Kranthi, Director, ICAR-CICR, felicitated all of them on the occasion. All the Scientists, administrative, technical, supporting and other staff were present on the occasion.



A farewell meeting was also organized at CICR, Sirsa on 31<sup>st</sup> August, 2015 for Smt Urmila Devi, Skilled Support Staff who retires after serving 35 years as casual labour, temporary status labour, and skilled support staff.



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