The Rubber Board
NEWS BULLETIN

World's First Genetically Modified Rubber Planted in Assam

Dr. James Jacob, Director (Research) handing over the GM plant to Dr. K.N. Raghavan, Executive Director, Rubber Board for planting at Sarutari Farm

History was made on 22 June 2021 when Dr. K. N. Raghavan IRS, Chairman and Executive Director of Rubber Board planted the world's first genetically modified (GM) rubber plant at the Board's Sarutari research farm in the outskirts of Guwahati. Developed at the Rubber Research Institute of India (RRII) under the Rubber Board through long years of painstaking research in its Biotechnology laboratory, this GM rubber plant is expected to grow well under the climatic conditions of the North East.

Addressing the media after inaugurating the field planting, Dr. Raghavan explained how the latest innovation can be a game changer in natural rubber cultivation in the country. With additional copies of the gene MnSOD (manganese-containing superoxide dismutase) inserted in it, the GM rubber plant is expected to tide over the severe cold conditions during winter which is a major factor affecting the growth of young rubber plants.

Natural rubber is a native of warm humid Amazon forests and it is not naturally suited for the cold conditions on this part of the country. Through breeding and selection, RRII has earlier developed two high yielding hybrid clones of rubber that are adapted to the climatic conditions of the North East. This is the first time any GM crop is developed exclusively for this region.

Growth of young rubber remains suspended during the winter months which are also characterized by progressive drying of the soil. This is the reason for the long

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Highlights

Keep cups inverted after latex collection

Rainy season is to begin in Kerala soon. In this context the Rubber Board requests all rubber growers to ensure that the latex collection cups in their holdings are kept in inverted position after collecting latex in the rainy season. This is because rainwater getting collected in the cups is a good medium for breeding of mosquitoes.

When tapping is carried out uninterruptedly, at least once every week, there is little chance for the water to remain in the cups for long. But as the monsoon sets in, tapping operations may be disrupted for longer periods, leading to proliferation of mosquitoes. Rainwater may also get collected in the folds of plastic rainguards fixed on the trees, in the old and damaged collection cups, other utensils and old plastic sheets lying discarded in the plantations. The Board requests all rubber growers and tappers to be careful to avoid such circumstances.

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immaturity period of this crop in the region. MnSOD gene has the ability to protect plants from the adverse effects of severe environmental stresses such as cold, drought etc.

Laboratory studies conducted at RRII at Kottayam, Kerala showed that GM rubber plants over-expressed the MnSOD gene as expected, offering protection to the cells. Therefore it is expected that the GM rubber plants will establish well and grow fast here.

Dr. Raghavan explained that what is planted now is not on a commercial basis, but on an experimental level following all mandatory biosafety measures applicable to field trials involving GM crops. He allayed unfounded fears about GM rubber. MnSOD gene used in the GM rubber was taken from the rubber plant itself. Its copies were multiplied in the laboratory and reinserted into a cell of the rubber plant which was then regenerated into a full plant that is now panted in the field. There are no plant species in India that can breed with natural rubber. Therefore, there is no risk of genes flowing from the GM rubber into any other native species, a concern often raised by environmental groups against GM plants in general.

Dr. Raghavan stated that Rubber Board attached great importance to its activities in the North East where rubber cultivation is a potential tool for rural development and empowerment of the peasants, including the indigenous communities of the region. It is actively promoting rubber

cultivation in the region with financial support given by the Indian tyre industry. Its choice Assam to plant the first GM rubber also demonstrates the importance it attaches to the region.

Conducted strictly adhering to Covid-19 protocols, the event was witnessed by a handful of officials of Rubber Board, soil conservation department and local rubber growers.

Important farm activities in July

Grower's Corner

Raising seedling nurseries

In South India, the fruits of Hevea ripen by the end of July and the dry fruits dehisce and the seeds are collected. The rubber seeds have shorter viability, however, the viability can be prolonged up to two months by mixing with moist charcoal powder and then packed in gunny bags lined with perforated polythene sheet or double gunny bags. Germination beds may be prepared in advance so that seeds can be sown for germination without much delay. The seeds are washed thoroughly and then sown in single layer touching one another and pressed firmly into the sand, with the surface of the seeds just visible above.Germination starts within six to seven days after sowing.

Seeds sprouted each day should be picked and planted in the nursery or in the fields as the case may be. Delay in transplanting may cause damage to the tender roots. Seeds which do not germinate within 2-3 weeks may be discarded.

Field planting

If weather is favourable, planting can be carried out during this month also.

Seedlings and budded stumps

Planting of seedling stumps and budded stumps should be done immediately after pulling out. While planting budded stumps, the bud patch should be just above the ground level to reduce the effects of elephant foot and infection by soil-borne pathogens.

Polybag plants

At the time of planting, the top whorl of leaves of the plant should be fully mature. A planting hole slightly bigger than the size of the polybag is made. The tip of the tap root, if grown out of the bag, should be removed. The bottom of the bag is cut and the bag along with the plant is placed in the hole, gradually filling the hole while keeping the soil core intact. The cut is continued as the bag is slit open and carefully removed. The soil is then packed firmly around the plants.

Root trainer plants

At transplanting, the root plug can be separated from the container without any damage by inverting it and giving a gentle tap of the rim of the root trainer cup to any hard surface. A planting hole can be made in the refilled planting pit by pressing the empty root trainer cup into soil. The root plug is carefully inserted into the planting hole and the soil around it is compacted. The root trainer plants show early establishment due to its well developed root system.

Weed control

Weeding should be carried out by adopting either manual methods or by use of herbicides in the rubber plantations. The weeds removed manually may be kept in plant rows which when dried can be used for mulching the plant base.

Disease control

Spraying Bordeaux mixture (1%) may be carried out at fortnightly intervals to protect young plants in the nursery as well as in the field against shoot rot disease.

Periodic inspection for detecting pink disease affected plants may be undertaken on sunny days as the disease is prevalent during southwest monsoon period. The main seat of infection is usually the fork region. Initially white or pink coloured cobweb mycelial growth on the bark surface may appear with streaks of latex oozing out from the lesions. Rotting, drying up and cracking of the affected bark will follow. In the early stages of infection Bordeaux paste has to be applied on the infected parts extending up to 30 cm above and below the affected areas. When the infection is in its advanced stage cracks are formed in the bark and exudation of latex occurs. In such cases Bordeaux paste may be applied initially and after drying, the affected region may be scraped to remove all the rotting bark and mycelium and then the paste is applied again as done earlier. Dried branches after disinfection should be pruned off and burnt. Application of fungicides like Thiride was found effective in containing the disease when incorporated (10g/kg) in a petroleum wound dressing compound.

If tapping is continued during the rainy season use of an effective panel protectant is essential to protect the tapping panel from bark rot which may occur during the season. If any leakage is found in the rainguards it should be rectified and if necessary it may be replaced with new ones.

Fungicide like Indofil M-45/Dithane M-45 (5 gm/l of water) or Akomin/Phosjet (2ml/litre) may be applied at weekly intervals on the tapping cut against bark rot disease. In trees where the infection is advanced and the panel is rotten, the surface may be scraped to remove the decaying tissues and washed with effective fungicide solution and then any of the wound dressing compounds like Rubberkot, Sopkot, Treseal etc. may be applied to the panel.

RRII decoded the entire Genome of RRII 105

Rubber Research Institute of India (RRII) under the Rubber Board has achieved a major breakthrough by decoding the entire genome of the most popular Indian hybrid rubber clone, RRII 105. This will have profound impact on research aimed at improving the genetic potential of rubber trees to produce more rubber and timber. This will also aid in evolving clones that can tolerate pests and diseases and adverse climatic conditions in a better manner.

RRII achieved a draft assembly of the genome sequence of RRII 105 with a size of 1.47 giga bases (i.e. 1,47 billion bases) with 94% completeness which is an excellent outcome for a de novo assembled tree genome. The genome assembly was accomplished by using genome sequence data obtained from deep sequencing using NGS platforms like Illumina, Pacbio and Roche 454. The sequence data generated was of good quality and sufficient enough to cover more than 200 fold of the genome of rubber. The completed genome assembly is one among the biggest tree genome sequenced from India.

Whole Genome Sequencing

These days genome sequencing and mutations happening in SARS CoV-2, the virus causing the Covid disease are everyday news. This virus has a genome size of about 30,000 bases (A,T,G and C). Rubber has a far more complex and large genome of size of nearly 1.5 to 1.6 gb (50,000 times bigger). Sequencing the whole genome, assembling the sequence into a meaningful form and annotating the genes of interest are extremely challenging, but exciting science.

Whole-genome sequencing is the analysis of the entire genomic DNA sequence of a cell, providing the order of all the nucleotides in an individual's DNA. Whole genome sequencing can also determine variations in any part of the genome. These variations (or more precisely called mutations that are inherited from forefathers and passed down the progenies) are responsible for the behaviour of individuals within a species, be it a plant, animal, human or a microbe.

In the case of rubber, different behaviour refers to differences among clones in terms of their growth, productivity, tolerance to pests and diseases, climate-resilience etc., qualities that are of great relevance to rubber cultivation.

Why whole genome sequencing?

Whole genome sequencing and assembly gives the most comprehensive characterization of the organism's decoded genome. This offers unprecedented possibilities in developing clones with most ideal agronomic traits. Some benefits of genome sequencing are the following.

- The breeding cycle in rubber (i.e. the time taken to develop, test and release of a new clone is almost 23-25 years. This period can be reduced by half with the help of the whole genome information.
- Annotating genes of agronomic importance improves the efficiency and accuracy of selecting smart clones for the future that have tolerance to pests and diseases, high rubber and timber production potential, shorter gestation period, adaptation to global warming and climatic change.
- Will speed up the process of making more GM rubber.
- Will make CRISPR/CAS-9 gene editing feasible in rubber.

Dr. K.N. Raghavan, Executive Director, Rubber Board releasng the the genome sequence of RRII 105

Thus whole genome sequencing is a powerful tool for genetic improvement of natural rubber, both through traditional breeding and most recent molecular breeding approaches.

What next?

The assembled genome information available with RRII will be used to extract meaningful biological information like the genes responsible for high yield, disease tolerance, climate resilience, TPD tolerance etc. Tools (molecular markers) for the selection of potential high yielding varieties at the juvenile stage itself will be developed in the research labs of RRII so that farmers get better performing clones more frequently from Rubber Board. The information generated will also be used for the designing of better performing GM rubber plants with enhanced yield, allergen free latex, climate resilience etc. It is anticipated that the completion of this ambitious project will enable the country to be in the forefront of rubber cultivation and productivity in the coming years. Researches pertaining to the above aspects are already in progress at RRII.

Other countries that have done rubber genome sequencing are China, Malaysia, Thailand and Japan.

This project was led by Dr. James Jacob, Director, RRII and the team included Dr. R. G. Kala , Dr. Thakurdas Saha, Dr. A. Thulaseedharan, Anantharmanan. R, Dr. Thomas. K. U, Dr. Bindu Roy, Dr. M. B. Mohammed Sathik, Dr. Molly Thomas, Dr. Shaji Philip and Mrs. Minimol Ravindran

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