LAW OF DIMINISHING MARGINAL RETURNS AND YIELD CEILING IN NATURAL RUBBER

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Genotypic variability in potential yield was analysed using the published yield data of as many as 622 *Hevea* clones derived from various field trials conducted by the Rubber Research Institute of India at different points of time in the past 70 years. These clones were experimental materials with promising yields or cultivated clones popular in Asia and were mostly of Wickham origin. They included ortets and hybrids between Wickham clones and a few hybrids between Wickham clones and wild Amazonian accessions in more recent times.

Since the trials were conducted with standard management practices in the agro-climatically better suitable traditional rubber growing regions of the country, the realised yields represent the potential yield of each clone. The frequency distribution of the 622 clones according to their potential yields followed a normal distribution with an extended distribution to the extreme right and with just one or two clones each falling in the highest yield classes. While there were eight clones appearing in the lowest yield class of <2 kg tree^{-1} year^{-1}, there were 12 clones falling in the very high yield classes between 11 and 16 kg tree^{-1} year^{-1}. The population mean was 5.3 kg tree^{-1} year^{-1} and the mode and median were 3.3 and 4.8 kg tree^{-1} year^{-1}, respectively.

From unselected trees with hardly an yield potential of one kg tree^{-1} year^{-1} planted at the beginning of rubber plantation industry in the country, popular clones of the later years such as Tjir 1 and RRIM 600 (until the 1960s/70s) showed better potential yields of 4.5 and 5 kg tree^{-1} year^{-1}, respectively. The first Indian high yielding clone, RRII 105 (1980) had an yield potential of 6.2 kg tree^{-1} year^{-1}, while the subsequently released five clones in the RRII 400 series (2005 to 2020) had a yield potential of 7.2 kg tree^{-1} year^{-1}. The present analysis indicates that yield potential of future clones, if any, to emerge from the present genetic resource, may stagnate at about 8-9 kg tree^{-1} year^{-1}. This clearly indicates that the available genomic resources are getting exhausted and the law of diminishing marginal returns will apply making future clone development with still higher yields increasingly difficult from the existing genetice stock. We discuss science-based strategies such as widening the genetic base of the breeding population (e.g. incorporating wild accessions collected from the Amazon and high yielders recently imported from other countries), applying latest developments in population genetics and genetic recombination, marker assisted molecular breeding and selection, ploidy manipulation and creation of pure-lines, gene editing *etc*. for breaking the yield ceiling in this species.

Key words: Crop improvement**,** Genetic resources, *Hevea brasiliensis*, Modern clones, Natural rubber, Yield ceiling, Yield potential

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